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**MAGAZINE**

MARCH 31, 1992

THE INDEPENDENT GUIDE TO PERSONAL COMPUTING

VOLUME 11 NUMBER 6

FIRST LOOKS



**386SLs: Three New Notebooks That Stretch Your Battery's Life**

CONNECTIVITY

**Networks Are Everywhere! A Survival Guide**

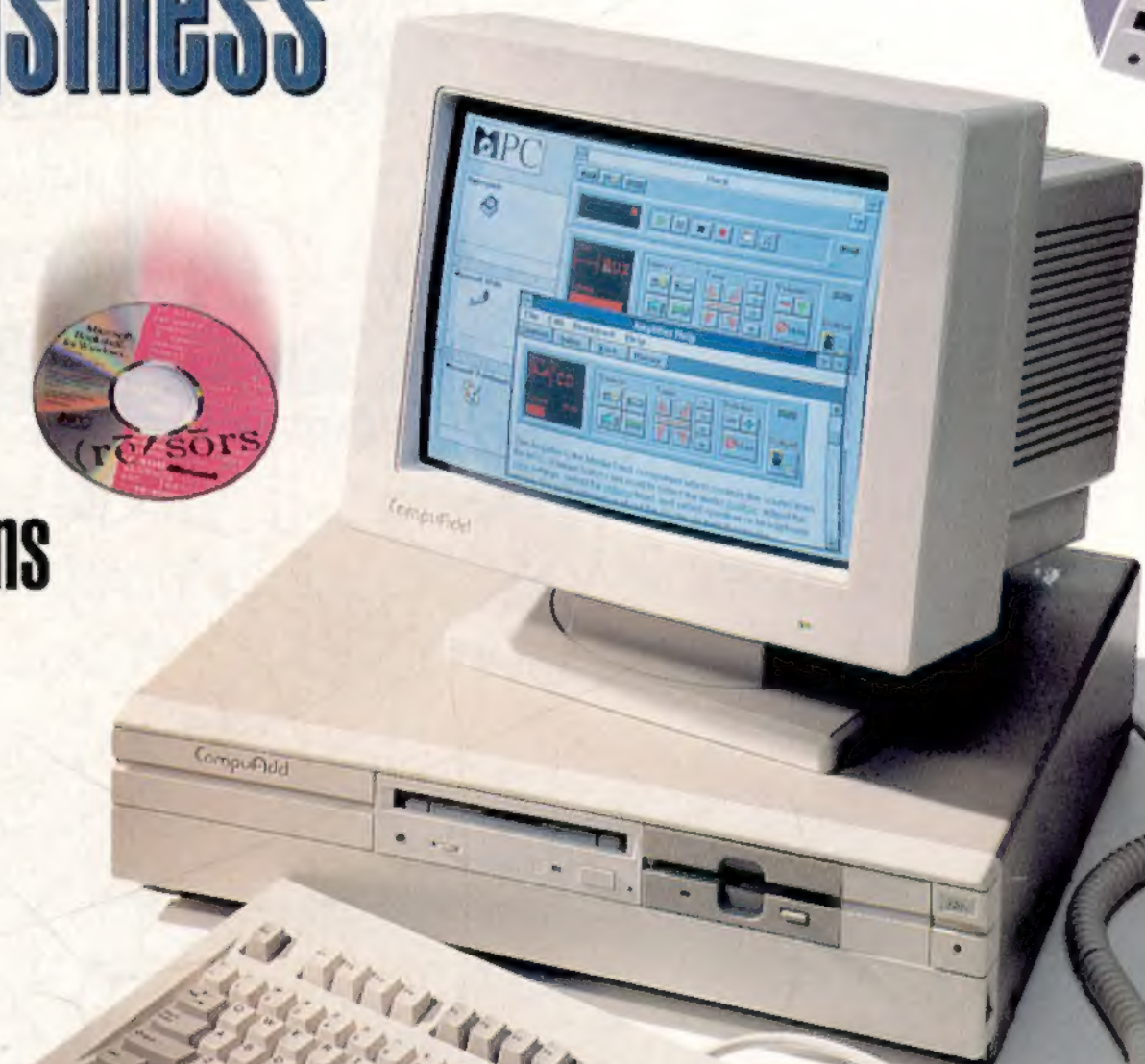
APPLICATIONS DEVELOPMENT

**Multiuser Databases: Nine That Challenge The Mainframes**

# MULTIMEDIA

## Gets Down to Business

- PCs and Upgrade Kits
- Tools to Create Extraordinary Presentations
- Music Software For a Better Pitch





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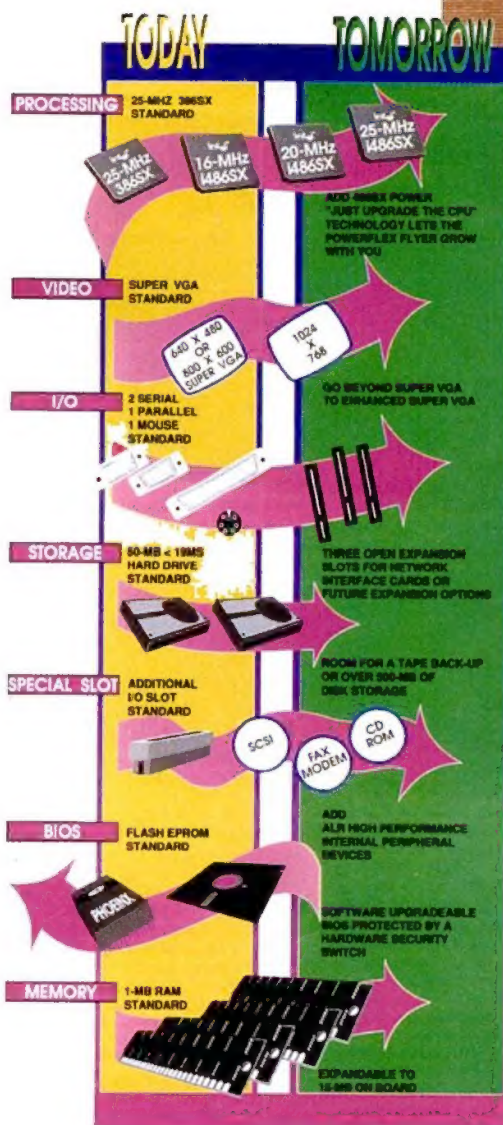
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CIRCLE 263 ON READER SERVICE CARD

# Inside

Over the past few months, *PC Magazine* editors have been doing a lot of traveling without leaving our headquarters at One Park Avenue in New York. We moved from our editorial offices on the fourth floor to the sixteenth floor and back down.

The reason for all this commotion: a vastly improved PC Magazine Labs. The lab has been an integral part of *PC Magazine* since 1985, but we outgrew the old facility. Our new high-tech 7,700-square-foot laboratory should keep us at the forefront of product testing in the nineties.

Our new lab has 53 general-purpose stations to test PCs, peripherals, and software. The test bench at each station is also equipped with Ethernet, Token-Ring, and fiber-optic connections. This will enable us to test each product's networking capabilities and compatibilities thoroughly. In addition, we have a bank of 36 PCs and four high-end servers dedicated exclusively to LAN testing, strengthening our reviews of servers, multiuser databases, and other network-based products.

The new lab reflects our goal to improve the quality and depth of the testing process constantly—the core of *PC Magazine's* editorial mission. In keeping with that goal, we've also made some changes in the way we write our reviews of PC systems. *PC Magazine*



strives to keep its reviews objective by submitting each product to a scripted battery of evaluations and by running performance and benchmark tests in our labs. In most categories, the individual reviews are then written by senior contributors, who are chosen for their expertise.

In personal computers, however, the number of products was getting so large and the number of tests so complicated that we felt we could produce

better, more consistent reviews by preparing the reviews internally. To achieve this, we have increased the number of technical analysts in the lab; they will be responsible both for testing the machines and writing the reviews of PCs.

You'll begin seeing the results of the

new lab and new procedures in the next issue, when we review the leading notebook computers. It will also be our first use of PC Bench 6.0, the latest revision to our popular benchmark program. Bench 6.0 has been enhanced to include more details on the performance of individual components and to better examine video performance as well as other workings of high-end systems.

At *PC Magazine*, we're committed to making sure that our testing procedures continue to evolve so we can give you the most complete, most accurate product evaluations.

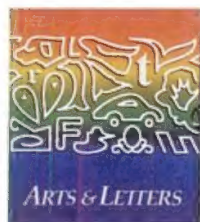
—Michael J. Miller



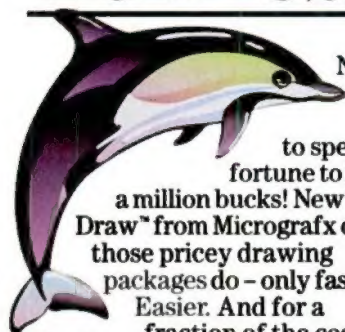
The new PC Magazine Labs is twice as large as the old Labs and wired for sophisticated network tests.

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# IN A CATEGORY OBSE AND LIGHTER, COMPAQ W ANOTHER ADJE

Make it smaller. Make it lighter. Make it lighter. Make it smaller.

These must be the mandates emblazoned upon every R&D document handed to the engineers of today's crop of notebook computers.

Admirable goals to be sure. Goals that the engineers at Compaq, however, believe fall well short of making the most of portable computing.

Which explains why the latest 386SL notebook technology from the labs in Houston — the new COMPAQ LTE Lite/25 and LTE Lite/20 PCs — are not only the lightest (a scant 6 lbs.) and the smallest (only 8.5"x11"x1.75") notebook PCs that we've ever built. They're also the smartest.

The COMPAQ Hibernation feature saves all open files to the hard drive and turns the unit off, either upon request or as an automatic feature. Power up the COMPAQ LTE Lite later and you're back exactly where you left off.

## THE BRAINS BEHIND THE OPERATION.

When it came time to design a new notebook, we started (logically enough) with the battery.

The new COMPAQ Power Smart Pack battery in our new notebooks delivers up to 4.5 hours of computing, a full hour longer than most.



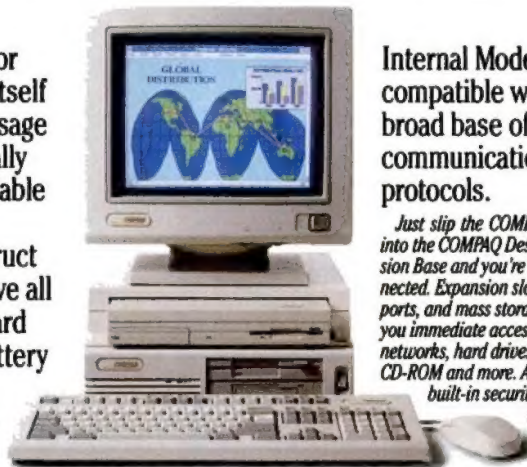
Accurate to within minutes, the COMPAQ Power Smart Pack battery gauge clearly displays remaining battery life at the touch of a button.

A microprocessor inside the battery itself monitors current usage levels and continually calculates the available power remaining.

It can even instruct the notebook to save all open files to the hard drive should the battery power run too low.

And the energy-saving features in our newest notebooks go far beyond the presence of an Intel 386SL chip.

To make the most of the smarter battery, the new COMPAQ LTE Lite also comes with user-adjustable power-drain settings, and three dif-



Internal Modem is compatible with the broad base of today's communications protocols.

Just slip the COMPAQ LTE Lite into the COMPAQ Desktop Expansion Base and you're instantly connected. Expansion slots, external ports, and mass storage bays give you immediate access to monitors, networks, hard drives, tape drives, CD-ROM and more. And all the while, built-in security features ensure a safe harbor for your notebook.

In modem talk, that means true V.32 9600-bps data transmission and V.42bis compression for up to 38.4 kbps throughput, as well as full support for Hayes AutoSync.

This little marvel negotiates the fastest transmission throughput that the other end of the line can muster, whether it's sending or receiving.

It even drops to a low power-drain standby state and monitors incoming signals if you're waiting for a call to come in.

Or for that matter, another modem to catch up.

## NOT ONLY SMART, BUT BRIGHT.

The new, efficient COMPAQ Maxlight VGA display makes for a much brighter screen than our previous notebooks, and does it without sacrificing battery life.

Sharper graphics and text in up



ferent sleep modes — System Idle, System Standby, and Hibernation.

## A MOST MODERN MODEM.

Our optional 9600-bps modem for the COMPAQ LTE Lite PCs would make even Alexander Graham B. proud.

The COMPAQ Enhanced 9600-bps



# DESIGNED WITH SMALLER WOULD LIKE TO SUGGEST EFFECTIVE: SMARTER.

to 64 shades of gray complement an enhanced video subsystem that's so fast it virtually eliminates "submarining," better known as "where did that #%\$\*\*# cursor go?"

## A NOTEBOOK THAT'S USELESS IN THE WRONG HANDS.

At Compaq, we realize that data security is every bit as important as hardware security.

At the hardware level, DriveLock locks the hard drive, preventing access to data even if the drive is removed.

One-touch QuickLock and QuickBlank functions



Isolated inverted "T" cursor controls are in a familiar position so you don't have to teach your fingers new tricks.

allow you to quickly (surprise) disable the keyboard or blank the screen.

And of course, our new notebooks come with a Keylock slot for an optional cable lock.

With all of the above, plus a 120-MB hard drive,\* RAM expansion to 10 MB, cache memory, simultaneous display, and an auxiliary battery, to say these are the best notebooks we've ever made would be something of an understatement.

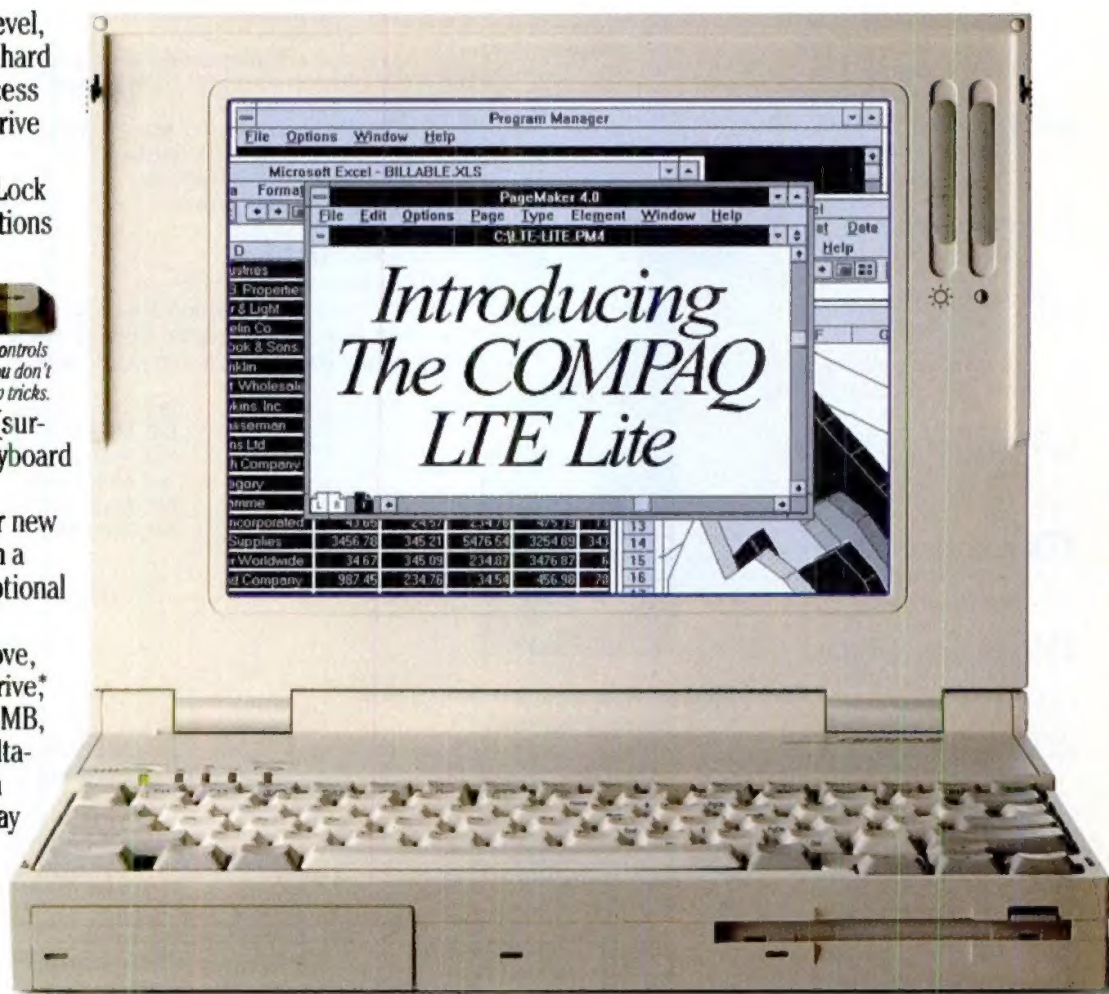
To back them with a one-year worldwide warranty and our toll-free Compaq Customer Support Center hotline would be more like it.



So don't choose between a small notebook and a smart notebook. Choose both.

Choose the new COMPAQ LTE Lite. For information about our new notebooks or an Authorized COMPAQ Reseller near you, call Compaq in the U.S. at 1-800-231-0900, Ext. 100, or in Canada at 1-800-263-5868, Ext. 100.

**COMPAQ**



Actual weight: 6 lbs. Actual dimensions: 8.5" x 11" x 1.75". Actually, this is the best notebook we've ever built.



## UP FRONT

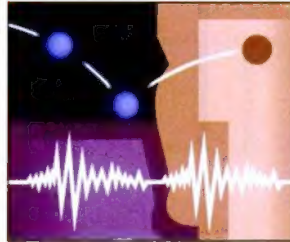
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### MULTIMEDIA

*Michael J. Miller/* In this special issue, *PC Magazine* tackles one of the industry's hottest topics—multimedia. By bringing sound, animation, and digitized video to the desktop PC, multimedia will change the way we think about and use computers. Read on to discover the multimedia offerings available today, how to get them, and how to make the technology work for you.

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#### Do They Meet the Challenge?

*Charles Petzold/* *PC Magazine* surveys the first generation of MPC upgrade kits and PCs. The five products reviewed offer fast CD-ROM drives, MIDI and waveform audio, and the ability to run applications designed for Microsoft Windows with Multimedia Extensions 1.0. But even with these advantages, are you better off waiting until the product category matures?

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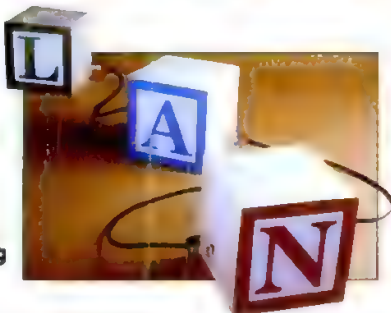
#### Connectivity Simplified:

#### An Introduction to the Ways of Networking

*Frank J. Derfler, Jr./* With a topic as broad as networking, fitting the parts into the big picture can be difficult for even the most experienced managers, let alone the novices. The first of two installments helps put it all into perspective.

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#### Robust and Ready to Share

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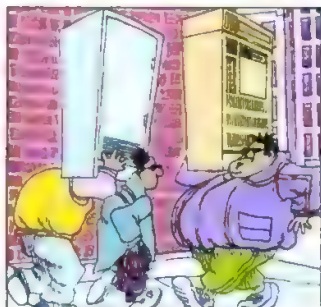
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Edward Mendelson  
PC Magazine, (June 25, 1991)

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# Letters

## THE BEST OF 1991

Bill Howard said in his "Best of 1991" article (January 14, 1992) that 1992 would be "the year of Windows applications," but he was "perplexed" at the miserable sales of midlevel Windows business products.

Midlevel users are knowledgeable regarding DOS and the DOS command structure. These users depend on their machines for day-to-day completion of their work and are not willing to lose valuable data or time for the questionable convenience of a front-end graphics package for DOS that is so unreliable.

Microsoft has successfully hyped the media and duped the software developers onto a path that most knowledgeable mid-level users are too smart to follow.

Roger L. Cartee  
Idaho Falls, Idaho

I was surprised to see that you selected the NEC 4FG MultiSync monitor as the "Best of 1991" even after your reviewer (M. David Stone, November 12, 1991) remarked about the monitor's convergence problems. I personally returned two of the monitors after noticing the same problem myself.

The 4FG is a revolutionary monitor—in theory. But until NEC corrects the convergence problems, the monitor is unacceptable. I would take a vanilla VGA monitor with a clear (converged) image over a blurry SVGA monitor with all the bells and whistles any day.

Thomas J. Kazan  
Huntington Beach, California

Your "Heaven's Gate—Ishtar—Hudson Hawk Products of the Decade" list ("Abort, Retry, Fail? Special Edition," January 14, 1992) is both funny and sad. The contemptuous name implies that these products were not only failures but turkeys too. But that isn't necessarily true, especially in the case of my old friend, the Victor 9000.

When the IBM PC first came out, the 9000 offered 128K of RAM (compared with the PC's standard 64K), 600K floppy



Some readers took exception with our "Best of 1991" product choices.

disks (compared with the PC's 180K), 800-by-400 monochrome graphics (were any graphics available for the PC?), one parallel and two serial ports, and an optional "audio toolkit" that could record and play back excellent digital sound. In addition, the Victor offered a hard disk model before the XT (IBM's hard disk model) was even a gleam in IBM's eye.

Unfortunately, Victor couldn't market its way out of a paper bag, and the 9000 wasn't completely IBM-compatible—chiefly because it *exceeded* the PC in so many areas. Slow sales and strategic goofs eventually killed it. So IBM won out, not because of its technical excellence but because great marketing always beats great technology.

I have moved on to "industry-standard" machines, but for awhile I was privileged to use and enjoy a product that was the *best*. Will I ever feel that way again?

Barry Cohen  
Brooklyn, New York

In your Abort, Retry, Fail? special edition, the term *disambiguation* is scoffed at. Good enough. Problem is that Lotus is not the

real perpetrator. This term was coined during the requirements-generation phase of the development of the Ada programming language for the Department of Defense. It was intended to mean *clarify*, and was laughed at even then because only the DOD and its friends would create such a huge word to replace a small and perfectly good normal English term. Of course, we use *functionality* when we could use *function* most of the time, so who are we to laugh?

Jon Bondy  
Ardmore, Pennsylvania

I really appreciated the 8th Annual Awards for Technical Excellence (December 31, 1991) and would like to suggest that you add another category: computer books and manuals. In recent years this field has grown in volume and quality, yet there are few if any awards for the best. Just cast back a few years and see how inadequate books and manuals often were!

Neil McLeod  
Newton Aycliffe, England

## CACHE CONTROLLER CONTROVERSY

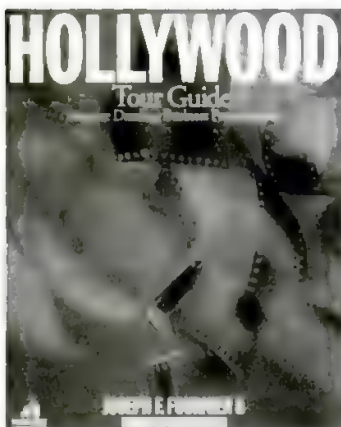
This letter is in reference to your review of 20-MHz 486SX PCs (December 31, 1991) and 40-MHz 386 PCs (January 14, 1992), regarding Northport's SC82C346 Cache Controller Chip.

The statements in your articles regarding an alleged timing/conventional memory problem are completely false, were not corroborated by any supporting data, and should never have been written.

In addition, it is our opinion that your memory tests do not reflect actual operating conditions, in which calls to memory result in "cache hits" approximately 90 percent of the time. Your test artificially forces "cache misses" around a 64K cache, a fact that we confirmed when, upon removing the cache and then rerunning your test, identical results were achieved. Your test demonstrates that a write-through cache outperforms a write-

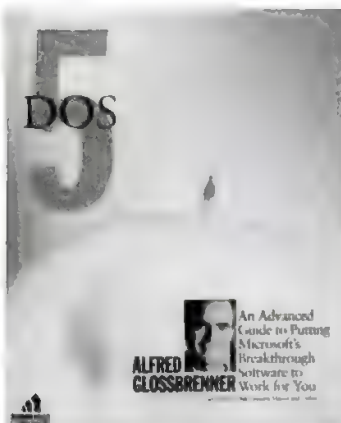


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## Letters

back cache, and also shows a performance increase of greater than 50 percent when changing the cache size to 256K. These results are absolutely ludicrous and simply not observed in reality. Your test does not accurately depict the performance of a 64K cache-based system, since the cache is effectively bypassed.

We find your conclusions very puzzling to say the least, since this chip utilizes the same architecture and memory timing that has won our clients many accolades, including numerous *PC Magazine* Editors' Choice awards (as recently as your January 14, 1992, issue), and *InfoWorld* Product of the Year. Approximately 30 percent of the systems that you reviewed utilize our product. Had you designed your test to reflect real-world operating conditions, you would have found, as our customers have, that the performance of Northport's write-back design is equal or superior to any cache memory controller currently on the market.

Jacques Benghiat, Ph.D.  
President, Northport Technology  
Fremont, California



Northport is correct that we did not find any defect in the design of the chip, and we regret the reference to a "timing" problem in the December 31, 1991, article. *PC Magazine* Labs' memory tests measure PC performance in simulations that we believe reflect realistic situations.

Speed is only one measure of the value of a product and we have frequently awarded Editors' Choice awards to machines that were not the fastest performers in a comparative review.—Ed.



### THE TAIL WAGS THE DOG

Mr. Dvorak's column "1992: The Year the Tail Wags the Dog" (January 14, 1992) indicates that he is getting a bit wishy-washy in his old age.

In his column, Dvorak blatantly puts Apple and IBM down for designing their own chip and tells them to stick to building machines. Yet in the Inside Track column, he writes, "IBM was the hottest company at Comdex. . . . The most interesting box released by IBM was its Ultimedia Model M57 SLC. This is one great machine. Utilizing the special IBM 386SLC (a speedy, cached 486-like chip designed by IBM) . . ."

Oops. What was that? Praise for Big Blue even though the previous page had nothing but condemnation for Big Blue? Hmmm. What is he really saying? Is he running for political office?

Rick Roberts  
Cincinnati, Ohio



### STATE OF THE INDUSTRY

When Intel announced the 486SX, many computer publications (including *PC Magazine*) rightly belittled Intel for producing a chip with only marketing in mind.

Unfortunately, after berating the scheme, the computer press seems to have swallowed it, possibly because it's good not only for Intel, but also for the advertisers who are producing 486SXs. Since last spring I have seen review after review of 486SX computers.

When I saw Jim Seymour's 486SX review in the December 31, 1991, issue, I groaned; not again! Then I looked at the title, "486SX: Great for Intel, but What About You?" Jim's article attacked the 486SX for benefiting only Intel and computer manufacturers, not the consumer. Well, I guess that's some consolation. Except for one thing: The article is still a review of 486SXs, not 486DXs!

It's little consolation that the story's Editors' Choice recommended a 386/33 or 486DX instead. I already knew that. What I needed to know was which 486DX!

Bart Barker  
Monroe, Connecticut



We reviewed 486s four times last year: February 12, 1991 (30 486/33 ISA); April 16, 1991 (22 486/33 EISA); June 11, 1991 (29 486/25s); and June 25, 1991 (32 486/25s). Already this year, our February 11, 1992, cover story reviewed 24 486/33s.—Ed.



### HURRAH! FOR TRENDS

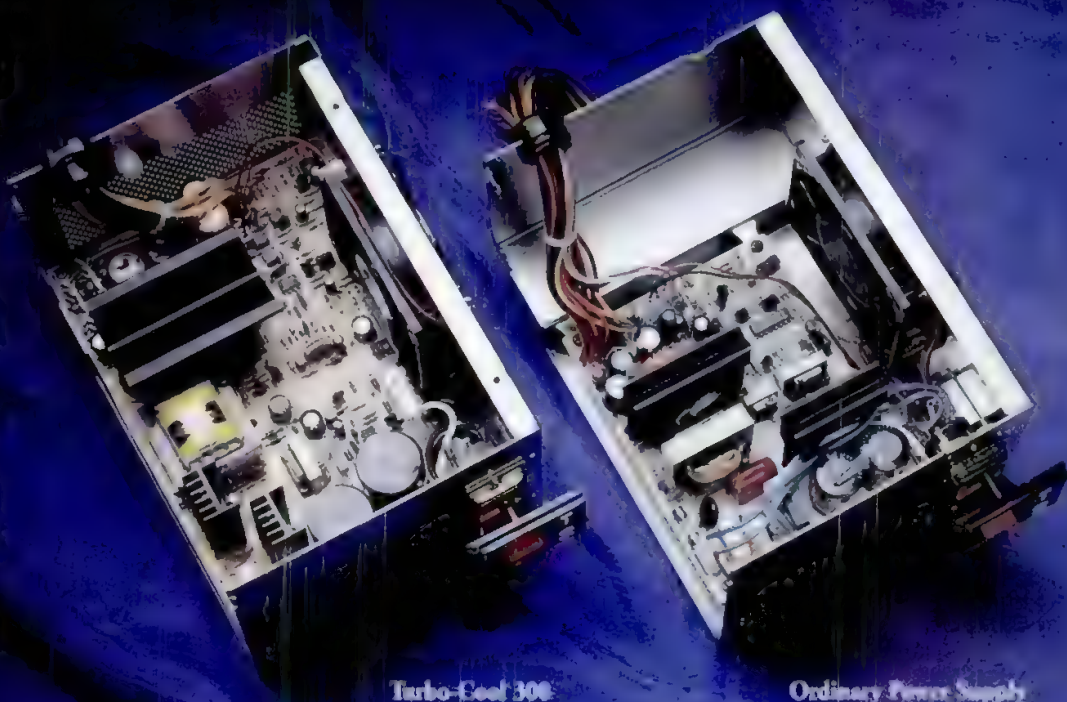
As a software consultant it's important for me to stay abreast of the industry. I've been a *PC Mag* subscriber for over a year and a half. Occasionally, I try other mags to see if I'm missing anything, but time and time again they disappoint me and I stick with *PC Mag*. The addition of the Trends section is the best thing you've done in a long time. Leave it in and keep expanding it. We nerds like to discuss industry developments, and our clients depend on us knowing trends. Don't lose this one. Thanks for a great magazine!

Wayne MacDonald  
Fort Wayne, Indiana



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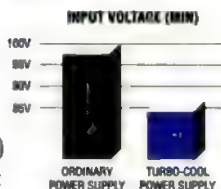
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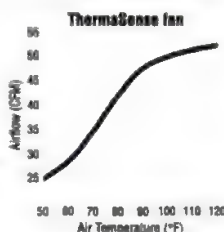
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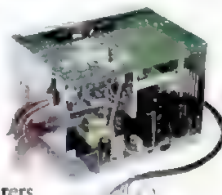
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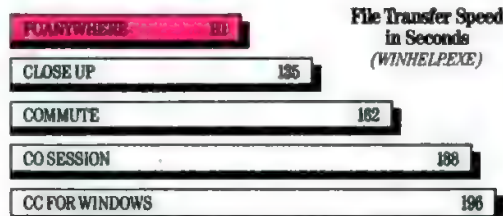
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## Letters

### CALLER ID

Just a brief note to comment on John Dvorak's praise of *Caller ID + Plus* (Inside Track, December 31, 1991). I'm sure the software is all he says it is, but I'm afraid I have to bring him down out of the clouds a bit regarding Caller ID itself.

Caller ID is the premium phone service that lets a called party know the phone number of the calling party before he answers the phone. John states that this will "virtually eliminate crank calls and stop anonymous harassment."

I'm sorry, but it will do no such thing! Any "crank caller" can prevent his number from being displayed at the called party's phone by dialing a simple code before dialing the number—something to do with federal privacy laws. I agree that makes Caller ID virtually worthless, but that's the way it is!

William A. Robinson  
Solon Mills, Illinois

### A CALL FOR SOMETHING ELSE

I would like to suggest that you publish—along with regular business phone numbers—the technical support numbers of the companies whose products are evaluated. At least you could mention the type of call (800 or 900) needed to receive assistance.

Roger S. Helgeson  
Kelso, Washington

### AMIGANS SPEAK OUT... AGAIN

I read your response to the Amiga versus Atari letters in the December 31, 1991, issue. I have only one response to the editor's addition. Maybe if *PC Magazine* would give a little ink to coverage of the Amiga, its users might not be rude.

Richard Erickson  
Burnsville, Minnesota

### MORE RECYCLING NEWS

Since Gwyn Magaditsch asked if anyone in the country recycled printer ribbon cartridges (Letters, December 31, 1991), several readers wrote in to say they did. We printed the names of two companies in our last issue; here are three more:

■ Northwest Ribbon Recycling and Supplies Inc., 8175 SW Nimbus, Bldg. 11, Beaverton, OR 97005; 503-641-5156; fax: 503-641-1636.

■ Southland Technology Inc., 1300 E. Arapaho Rd., #103, Richardson, TX 75081; 800-458-9777, 214-680-1151.

■ Andrew Inwek, 7830 Argus Rd., Philadelphia, PA 19150-1302; 215-424-5227.

Our thanks to Fred Kroon, Bob Groff, and Andrew Inwek for their contributions.—Ed.

### CORRECTIONS & AMPLIFICATIONS

In Bill Machrone's January 28, 1992, column "Special-Purpose Software," he should have referred to his favorite Power Up Software utility as *Labels Unlimited 3.0*.

In New & Improved Briefs, January 28, 1992, the phone number for Vertex Design Systems should have read 415-957-2799.

The *DataFlow* utility from IMS (New & Improved, January 14, 1992) can export any selected data from *dBASE*, *Paradox*, and ASCII files to another ASCII file, but it does not perform direct conversions among these three formats. Also, the article should have mentioned that *DataFlow* can define columns of fields in any ASCII file, not just delimited files.

In "Networking CD-ROMs: The Power of Shared Access" (December 31, 1991), there were some instances where the Editors' Choice logo was incorrectly printed above Meridian's *CD Net* Model 314. In fact, the Editors' Choice award in that story was shared only by Meridian's *CD Net* software and MDI's *SCSI Express* software. In our Editors' Choice sidebar, the *CD Net* Model 314 (which works in conjunction with the *CD Net* software) was singled out for its performance, useful features, and well-implemented design, but was not awarded the Editors' Choice.

### HOW TO WRITE TO PC MAGAZINE

We welcome your comments, complaints, insights, and suggestions. Please send them to Letters, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see page 10 for access information). All letters become the property of *PC Magazine* and are subject to editing.

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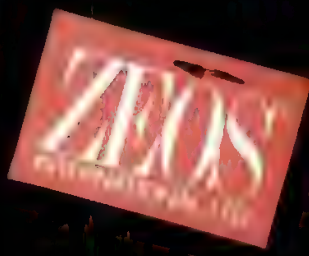
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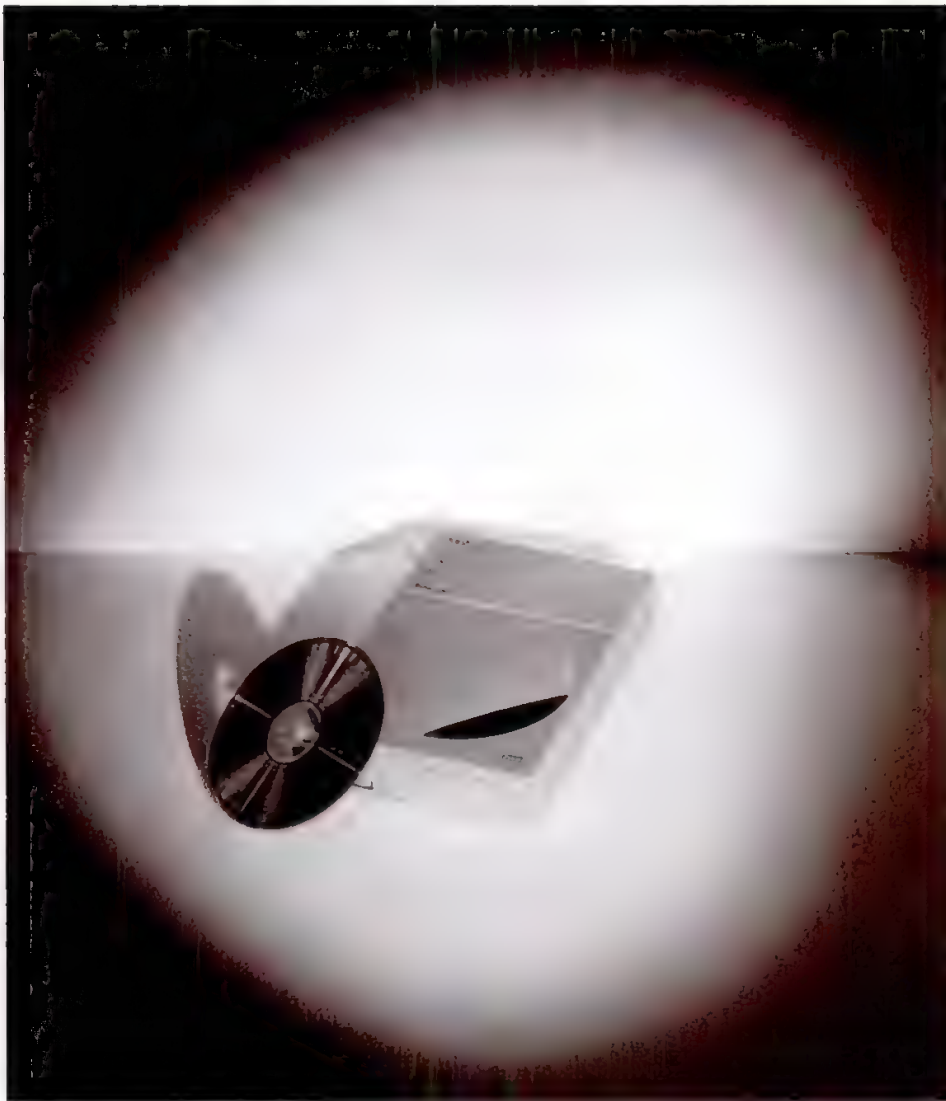




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|---------------------------------------------------------|----------------------------|-------------------------------|------------------------|------------------------|-------------|-----------------------------|----------------------------------------------------|-------------------------------|---------------------------|-------------------------------------|-------------------------|
| Colorado QJ-10<br>(Colorado Memory<br>Systems Inc.)     | 94                         | 3.6/2.0                       | 89                     | 88                     | 89          | 80                          | 80                                                 | 78                            | 91                        | 78                                  | 83                      |
| Mountain FileSafe<br>TD4440 (Mountain<br>Computer Inc.) | 78                         | 4.7/2.0                       | 63                     | 62                     | 82          | 74                          | 74                                                 | 73                            | 80                        | 72                                  | 79                      |
| ArchiveXL 40<br>(Archive Corp.)                         | 77                         | 6.4/3.0                       | 84                     | 81                     | 84          | 76                          | 76                                                 | 70                            | 79                        | 68                                  | 77                      |
| Tecmar QT-40i<br>(Tecmar Inc.)                          | 77                         | 6.9/3.0                       | 82                     | 82                     | 81          | 73                          | 73                                                 | 72                            | 73                        | 77                                  | 77                      |
| Everex Excel 40AT<br>(Everex Systems Inc.)              | 76                         | 3.8/2.0                       | 83                     | 80                     | 80          | 89                          | 71                                                 | 70                            | 77                        | 72                                  | 76                      |
| Irwin Model 145<br>(Irwin-Cipher Data<br>Products Inc.) | 72                         | 8.9/2.0                       | 77                     | 76                     | 74          | 70                          | 70                                                 | 68                            | 71                        | 67                                  | 74                      |
| Tallgrass TQ-1140<br>(Tallgrass<br>Technologies Corp.)  | 68                         | 2.5/2.0                       | 72                     | 72                     | 73          | 64                          | 67                                                 | 66                            | 64                        | 66                                  | 67                      |

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# Trends

*Trends & Technology Shaping the Personal Computer Market*

## Intel Fills Vacancy: New Chips Boost 486 Speed by 70 Percent

Intel is finally ready to turn off the neon "vacancy" sign it has been touting in its ads for 486SX PC systems. Months after the ad campaign began, Intel is about to introduce upgrade processors that will double the clock speed of its 486SX and 486DX CPUs. The new chips promise to boost system performance by roughly 70 percent.

Although the technology is called clock doubling, it doesn't actually double overall system

speed; it doubles the speed of internal processing. A true 50-MHz chip will run faster than a clock-doubled 25-MHz chip, but the accelerated chips will affect performance dramatically, Intel claims. The 486 chip, with its 8K of on-board cache, processes about 95 percent of the work in DOS applications and 90 percent in Windows apps internally, according to Intel. Initially, the maximum clock-doubling speed will be 66 MHz for the 33-MHz



486DX, but a 100-MHz clock-doubler is planned for the 50-MHz 486DX.

Intel will sell the chips to end users and system vendors. Clock-doubled upgrade processors for 16-, 20-, and 25-MHz 486SX machines are expected to show

up in retail stores as early as March. Priced around \$500, they will fit into the performance enhancement (or upgrade) socket. Most 486SX systems have the socket on-board, which means that installing an upgrade

CONTINUES ON PAGE 30

## Honey, I Shrunk the Slot (And Nothing Fits)

What happens when technology comes to your computer before all the pieces are in place? That's the problem posed by the new credit card-size peripheral standard that laptop makers have leaped to embrace. The new standard is called the PCMCIA 2.0 (for Personal Computer Memory Card International Association expansion card) or JEIDA (for Japan Electronic Industry Development Association).

PCMCIA describes a 2-by-3-inch slot accepting cards 3.5- or 5-mm. thick (both fit in the same slot) for laptop, notebook, and palmtop computers. Virtu-



**PCMCIA-card modems, when they show up, will use an ungainly adapter cable.**

ally no PC cards are shipping now, but many are slated to arrive by the second half of the year.

More than a dozen major notebook and palmtop manufacturers support PCMCIA, including Compaq, Hewlett-Packard, Poqet, Texas Instruments, and Toshiba, (all shipping products); and Apple, Dell, IBM, Li-

brex, and Zenith Data. Some, like Compaq, offer a belt-and-suspenders solution: Compaq's new 80386SL-based Lite series includes both PCMCIA 1.0 and proprietary internal modem slots; the latter

is able to accept a 9,600-bps data/fax modem. Unfortunately, that wasn't readily available either.

Consider Toshiba's superb T2200SX notebook computer, which lost its proprietary modem slot in favor of the more compact PCMCIA slot. The Intel-built, Toshiba-labeled 2,400-bps card modem is generally unavailable, and the few that are

jam in the slot. You also need a gawky adapter cable because RJ11 phone jacks are too big to fit on the card, and there is currently no way to route the phone signal back through your laptop, where an RJ11 jack would fit handily.

When PC cards do start showing up, they'll be great: 9,600- or

CONTINUES ON PAGE 32

## The Next (And Last?) Modem Standard

Today's fastest V.32bis 9,600-bps modems (which deliver throughput of 57,600 bps with compression) are whirlwinds compared with the 1,200- and 2,400-bps modems that have long been standards. But tomorrow's modems promise even higher speeds. A CCITT committee called Study Group XVII is hard at work on the next major modem standard. Dubbed V.fast by many, it is thought to be V.last by some. The new standard is called V.fast because it will achieve data transfer speeds that

were thought to be impossible over ordinary phone lines a few years ago, and V.last because it may approach the maximum possible throughput over these lines.

Until the committee finalizes V.fast, we won't know for sure what speeds it will support (or what its real name will be), but it seems likely that the upper limit will be at least 24,000 bps and might even be 28,400 bps (or 113,000 bps with compression) over common telephone lines.

CONTINUES ON PAGE 32





## Pipeline

by Gus Venditto

# Intel Lowers Prices, Increases Speeds

When the 486 chip was still a rumor, the running joke was that it would be impressive, but, "Hey, how 'bout that 686?"

Intel has never minded speculation about the race it runs with itself, because for years, this kind of talk helped keep Intel dominant in the PC industry. Today, however, some of that talk has been replaced by speculation about AMD's next speed record, often without a response from Intel.

Although Intel has begun to talk publicly about the wonders of its next generation P5 (probably the 586), which will be capable of delivering 100 mips (million instructions per second), the company is taking it easy with the "faster is better and newer is best" talk. These days, it's more likely for a new product from Intel to be slower than its predecessors and to deliver fewer features.

### BACKWARD STEP

While it's certainly true that today Intel is focusing on speed with its clock-doubling technology (see "Intel Fills Vacancy: New Chips Boost 486 Speed by 70 Percent," preceding page), just yesterday Intel was getting a lot of press for stepping backward—with the 486SX. Intel took it on the chin by announcing that it had disabled the 486's floating-point unit to create the 486SX. The chip was soon called "the brain-dead 486" by many. It was an unfair charge, since Intel also dropped the price of the chip. But it's easy to see why many people were unhappy: Progress in silicon always brings more features and higher speeds. Prices are supposed to drop after the technology's been improved, not before. The kind of packaging we all accept in the auto showroom and at the supermarket just isn't done in the high-tech world.

Intel, however, is sticking to its guns. Most of its new processor models will be a result of fine-tuning the current 386 and 486 lines with modest improvements. In the next year, it expects to create 31 new models that provide choices in speed, power management, cache, and floating-point units. Intel is talking about bringing the power management features in the SL to the 486 design.

One of the products in development is a cheaper version of the 386SL, the chip that features built-in power management interrupts. The new part will be the exact same chip that's in today's new 20-MHz 386SL laptops except that it won't have a working cache controller. As a result, Intel will lower the price by 25 percent. And while there are both 20- and 25-MHz versions of the 386SL, the new part will be available only at 20 MHz.

The new product was created because of demand from laptop makers who were planning to waste the cache controller anyway; they were reluctant to devote valuable system-board space to the extra RAM that the cache requires.

Intel risks more criticism with this new product because the cacheless 386SL contains the logic for the cache. Like the floating-point unit in the 486SX, the 386SL's cache is disabled. The real motivation is that perfecting a new chip design and putting it into production is so expensive that it's cheaper to deliver goods with nonworking parts than to create a new design.

Many people who buy a cacheless 386SL laptop probably won't care what's on the chip as long as it runs their software and they get a good price on the model. And those who know the difference will have more choices of performance versus cost. ■

## Vacancy Filled

CONTINUED FROM PAGE 29

processor on a 486SX-based PC should be as easy as installing a math coprocessor. For 486DX-based systems, which lack a coprocessor slot (math coprocessor functions are built into the chip), the upgrade path is more difficult. Intel is still working on a solution.

Although there have been no announcements, systems based

on the forthcoming chips should arrive soon, starting with 25/50-MHz 486SX-based PCs. ALR, AST, and Compaq say one benefit of the clock-doubled chips is that they work with existing system-board designs. Because the 25/50-MHz chip costs less than Intel's true 50-MHz CPU, it's a good candidate for inexpensive—but powerful—486 desktop systems.

—Mary Kathleen Flynn

# Avoiding Viruses From Vendors

Staying away from bulletin boards may not be a foolproof way to avoid viruses. Your next infection could come from a shrink-wrapped application—or even a new PC. Last December, Novell distributed 3,800 Network Support Encyclopedia disks infected with the Stoned III virus, generating more attention than Aldus got in 1988 when the developer shipped infected

disks of *Freehand* 1.0 for the Macintosh. But Novell isn't alone. Also in December, Leading Edge shipped approximately 500 PCs carrying the Michelangelo virus, and Chicago-area retailer Elek-Tek sold preformatted floppy disks infected with the Ping Pong virus.

Richard King, Novell's vice president of service and support, warns that all vendors are vul-

# Michelangelo Strikes: Beware The 6th of March

For those of you fortunate enough to read this before March 6th, stop right now and scan your PC for viruses. You may be able to catch Michelangelo before the boot sector virus does any damage to your system on the artist's birthday. The strain was first discovered in April of 1991; since then there have been over one thousand reported infections, according to McAfee Associates.

Michelangelo, a deadly strain of the Stoned virus, will overwrite a hard disk with random

characters from system memory only on March 6th; until then it remains memory resident, where it can be detected by antivirus software. According to Patricia Hoffman, author of *Hypertext VSUM*, Michelangelo has recently become the second most common virus and will soon be even more prevalent than the Stoned virus.

The first computer virus, the Pakistani Brain, was discovered in 1986. Today, there are about 1,000 known viruses, 100 of

## Protect Yourself

Today, there's more to safe computing than avoiding bulletin boards. To protect yourself, we recommend these steps:

- 1) Scan every disk before you put it on your system.
- 2) Back up regularly.
- 3) Select a reliable antivirus product and use it religiously (see the October 29, 1991, issue of *PC Magazine* for reviews of antivirus programs).—MKF



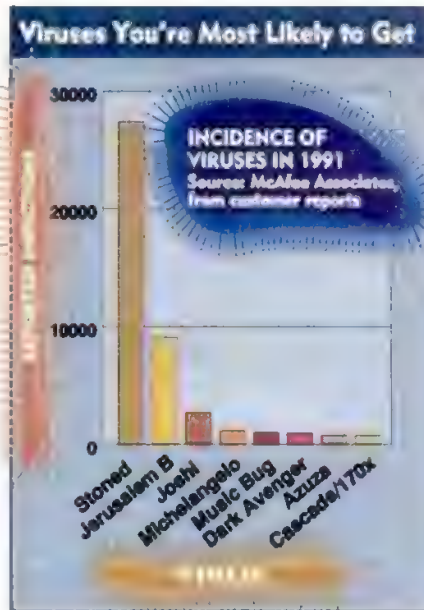
nerable because most antivirus software works only with known viruses. King said the infected disks that Novell sent to customers had been scanned with a version of *Scan and Clean* that didn't include the Stoned III virus.

How likely you are to get a virus is tough to gauge. John McAfee of *Clean and Scan* developer McAfee Associates says that hardware and software companies send out at least 1,000 infected disks a week. Patricia Hoffman, who publishes a \$30 shareware information package called *Hypertext VSUM* (408-988-3773) also believes that infected off-the-shelf products are increasing. She says the problem is cropping up in the disk duplication process, where an infected master floppy disk can pass on the virus to thousands of disks.

Robert Bales, executive director of the National Computer Security Association (NCSA), thinks the threat of viruses is serious but that the threat from vendors is overblown. Last fall

the NCSA, an organization of end-user companies that does research on security issues (717-258-1816), requisitioned market research firm Dataquest to do a survey on viruses. Of the more than 600 companies that participated in the survey, 63 percent had experienced at least one virus. According to these corporate users, the primary means of infection was disks brought from home. Only 3 percent blamed shrink-wrapped software and just 1 percent said the virus came with the PC; 43 percent blamed disks from home.

Like Bales, Tori Case, product manager for *Central Point Anti-Virus*, believes that most



vendors have enough quality-control measures in place but cautions that retailers are often not so conscientious. She says stores often re-shrink-wrap and resell returned packages that are sometimes infected.

—Mary Kathleen Flynn

which are reported regularly. Viruses are classified under two categories: file infectors, which attach themselves to an executable file (.COM, .EXE, .SYS, etc.) so when the program is run, the virus is also executed; and boot-sector parasites, which recode the boot sector of hard and floppy disks so that the virus is loaded into memory where it can spread to other disks. A common misconception is that you can't get a boot-sector virus from a floppy disk, but in fact you can infect your hard disk by rebooting your system while an infected floppy disk is in your drive (even if you take it out when you get the standard error message).

Here is a breakdown of the nine most common viruses in their respective categories:

### BOOT-SECTOR INFECTORS:

**STONED:** The Stoned virus is the most widely reported one today. It may display "Your PC is Stoned—LEGALIZE MARIJUANA" or another similar message. It damages your system's directory and file allocation

table (FAT).

**MICHELANGELO:** If this strain of the Stoned virus has become memory resident, a DOS CHKDSK will report a drop of about 2,048 bytes in total system memory. It will begin to infect boot sectors of disks as they are accessed, and on March 6th, Michelangelo's birthday, it will overwrite your system's hard disk with random characters from system memory.

**JOSHI:** If your system reports a 6K decrease in memory for no apparent reason, you may be getting this message on the fifth of every January: "Type Happy Birthday Joshi". Your computer will hang until you type the requested message.

**MUSIC BUG:** Once this bug becomes memory resident, every time a user tries to access a disk, annoying music is heard through the PC's speakers.

**AZUZA:** Once resident in your system's memory, Azuza infects all disks when they are accessed with write intent. The virus keeps track of how many times the system is booted from infected disks. After 32 tries, Azuza disables your COM1 and LPT1 ports.

### PING PONG AND PING PONG

**B:** Ping Pong, which had been considered extinct, was a boot-sector infector that infects only floppy disks. The virus, which activates on a random basis, displays a bouncing ball on your screen and forces you to reboot to regain control of your system. Ping Pong-B is virtually the same virus except that it can infect hard disks as well as floppy disks.

### FILE INFECTORS:

**JERUSALEM B:** A strain of the original Jerusalem virus, Jerusalem B slows down system speed, and black boxes begin to appear on your monitor. Every Friday the 13th, each file you execute automatically erases.

**DARK AVENGER:** This virus increases your files by 1,800 bytes, then corrupts them so they can't be read or executed.

**CASCADE/170x:** Causes all characters on your monitor to fall into a pile at the bottom of your screen. Cascade has four variants, 1701, 1701-B, 1704-D, and 17Y4. All activate in the fall of each year and do primarily the same thing.—Tin Albano

## TOP 15 Software Sellers at Retail

| RANK | COMPANY                                              |
|------|------------------------------------------------------|
| 1    | Turbo Tax Personal 1040<br>Chipsoft                  |
| 2    | Quicken 5.0<br>Intuit                                |
| 3    | Microsoft DOS 5.0 Upgrade Kit<br>Microsoft Corp.     |
| 4    | QEMM-386 6.0<br>Quarterdeck Office Systems           |
| 5    | WordPerfect 5.1<br>WordPerfect Corp.                 |
| 6    | Stacker 2.0<br>Stac Electronics Inc.                 |
| 7    | Microsoft Windows 3.0<br>Microsoft Corp.             |
| 8    | Word for Windows Upgrade 2.0<br>Microsoft Corp.      |
| 9    | Quickpay 2.0<br>Intuit                               |
| 10   | DR DOS 6.0<br>Digital Research Inc.                  |
| 11   | Learn to Use DOS<br>Individual Software              |
| 12   | Money for Windows<br>Microsoft Corp.                 |
| 13   | WordPerfect for Windows Tradeup<br>WordPerfect Corp. |
| 14   | ProComm Plus 2.0<br>Datastorm Technologies           |
| 15   | Lotus 1-2-3 2.3<br>Lotus Development Corp.           |

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending January 25, 1992. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a picture of the entire software market.

Sales information compiled by Ingram-Micro



## BRIEFS

■ **Notebooks:** Competition gets fiercer as companies slash prices and roll out new products. NEC reduced the prices of its 20-MHz 386SX- and 386SL-based UltraLite notebooks 10 to 20 percent, and Toshiba trimmed the prices of its 16- and 20-MHz 386SX-based T2000SX notebooks 5 to 12 percent. Meanwhile, Compaq brought out its first 386SL-based notebooks. The 6-pound 20- and 25-MHz 386SL-based Compaq LTE Lites cost between \$2,899 and \$4,699. And IBM is expected to introduce a 16-MHz 386SX-based 6-pound notebook called the PS/2 Note, priced to compete with the clones.

■ **Desktops:** IBM cut the prices of its 20-MHz 386SX-based PS/2 Models 35SX, 35LS, and 40SX by 10 to 16 percent.

■ **Information Services:** CompuServe, the second-largest on-line service after Prodigy, has followed Prodigy's lead and is offering a fixed-rate fee. For \$7.95 a month, members get mail, weather, numerous databases, EasySabra airline information, and games. Pay-as-you-go pricing stays in place for PC MagNet and Computer Database Plus.

■ **Electronic Periodical:** Multimedia is the medium but not the message in R&R Development Corp.'s new periodical for Windows business users. Distributed on-disk as a Windows application, the Windows Information Manager will use sound, animation, and hypertext with Windows 3.1, which will include Multimedia Extensions. An annual subscription costs \$345 (800-756-8850).

■ **Home Computing:** While most CD-ROM drives cost from \$400 to \$1,000, Nintendo developed a CD-ROM accessory for its Super Nintendo Entertainment System with a list price of \$200. By 1993, Nintendo's CD-ROM will use the CD-ROM XA format (which interleaves audio and video).

## APM Spec Extends Battery Life

With the Advanced Power Management (APM) specification, Microsoft and Intel are using their muscle to save energy. The spec, which grew out of Microsoft's Portable Computing Initiative, is designed to extend battery life up to 25 percent in portable computers.

Until now, there were two ways to make your battery last longer: use proprietary power-saving features such as Toshiba's, or use a power-aware BIOS with an Intel 386SL. APM works with both methods to deliver additional power savings.

APM works in tandem with a device driver and an APM-aware BIOS. Through the device driver, the operating system tells the BIOS when system resources—such as the keyboard, screen, mouse, I/O ports, and CPU—are not in use. The BIOS then powers the battery down.

APM works with any Intel architecture CPU. So even though Intel developed the spec with Microsoft, APM will also work with Intel-clone microprocessors from AMD and Chips



and Technologies. Laptop vendors, including ALR and Toshiba, plan to implement APM in their portables by mid-year. Current systems that have a Flash BIOS can be made APM-aware with a software upgrade provided

by the manufacturers.

Both MS-DOS 5 and the forthcoming Windows 3.1 support APM. DOS 5 already incorporates a POWER.EXE driver that Microsoft makes available to OEMs. A number of BIOS makers, including Phoenix Technologies, are making APM-aware BIOS software.

Other aspects of Microsoft's Portable Computing Initiative include ROM-based versions of MS-DOS 5 and Windows 3.1 (not ready in time to ship with the operating system in April), PCMCIA (see "Honey, I Shrunk the Slot (And Nothing Fits)," in this issue), Flash File system drivers, and a file transfer utility called InterLink.

Complete power management won't be achieved until all components of a sys-

tem, including applications, are power aware. But the APM spec, which is open to all hardware and software vendors, may be the keystone to system-wide power management.

—Christopher Barr

### Modems

CONTINUED FROM PAGE 29

Even more impressive, V.fast will be able to optimize throughput on any phone line because of advances in coding and equalization.

When will the CCITT officially approve V.fast? Formal approval will probably wait until late 1993, but the committee hopes to have a solid proposal ready by June of that year. Because modem manufacturers are already working on V.fast, modems are likely to be available soon thereafter. Exact pricing is impossible to fix, but best guesses are that the price of the new modems will be about what V.32bis modems cost when they first appeared—around \$1,200.

The next standard will probably also include a function to do line probing so that the characteristics of the phone line can be measured before data transfer

begins; the ability to place the carrier in the middle of the usable channel bandwidth instead of at 1800 Hz, as V.32 and V.32bis must; and an adjustable symbol rate so that bandwidth can be adjusted in order to fit the channel—another improvement over V.32 and V.32bis, which have a fixed symbol rate of 2,400 Hz.

The limit on how fast modems can go is called the *maxi-*

*mum capacity of a channel*, and Shannon's law proves mathematically that the limit exists. What is possible today is what our phone lines will accommodate. If phone lines improve dramatically, the maximum capacity will also increase, but advances in modem technology are more likely to have a significant impact on throughput than improvement on phone lines.

—Rick Ayre

### Shrunk Slot

CONTINUED FROM PAGE 29

14,400-bps data-fax modems, network adapters, 5 to 20MB of nonvolatile flash memory, and execute-in-place software applications, which means they don't use your computer's 640K base memory.

Nearly half a dozen modem makers are working on high-speed PCMCIA data/fax modems, most of which are based on chip sets from AT&T (which

claims low power consumption), or Rockwell (the market leader, which claims greater compatibility).

If you need to have a high-speed communications solution immediately, then consider modems from Telebit Corp. (408-734-4333), World-Port/U.S. Robotics (708-982-5010), or from Megahertz (801-272-6000), which should be available shortly.

—Bill Howard



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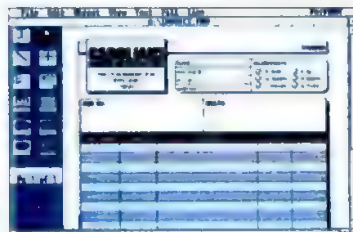
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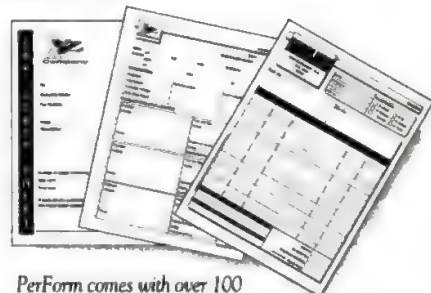


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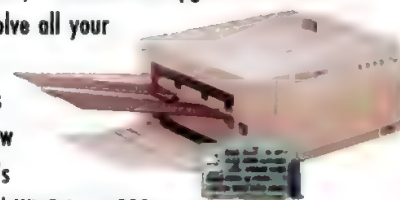
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CIRCLE 237 ON READER SERVICE CARD



# First Looks

Hands-on Reviews of the Latest Products

## Toshiba Fits 486 Power And Active-Matrix Color into Pricy 13-Pound T6400 Laptop

HANDS ON  
by Bruce Brown

Ever lighter notebook computers are all the rage, but there's still a demand for high-powered portable systems, even if they weigh more than 6 pounds. Toshiba's new line of active-matrix color portables brings new levels of performance to laptops. You can't run them on battery power, and the prices are high, but you get a lot in return.

The T6400 series includes two different processors and two different screen types. The least expensive model, the \$5,699 T6400SX, a 25-MHz 486, comes with a gas plasma screen and a 120MB 19-millisecond hard disk.



With its power supply built in, the \$9,749 Toshiba T6400DXC needs only a power cord and AC outlet to power its sharp 256-color TFT display.

Adding the active-matrix color display changes the model designation to T6400SXC and raises the price to \$8,449.

The T6400DX, a 33-MHz 486 with a 200MB 12-ms. hard disk,

lists for \$6,999 with the gas plasma screen. With the thin-film transistor (TFT) color display, it's called the T6400DXC and costs \$9,749. Our test system was the T6400DXC with the 120MB

### PC MARCH 31 REVIEW INDEX

**Three 386SL Notebooks**  
SL chip breathes longer battery life into Compaq, Dell, and Zenith notebooks.....38

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**SQLBase 5.0**  
Gupta's database server meets NetWare/386.....49

hard disk installed.

Both T6400s come standard with 4MB RAM, expandable to a maximum 20MB via plug-in credit card-style memory modules. Other standard features include a 3.5-inch 1.44MB floppy disk drive, one serial port, one

CONTINUES ON PAGE 42

## Mathematica for Windows: Reshaping Math Software With Graphics and Sound

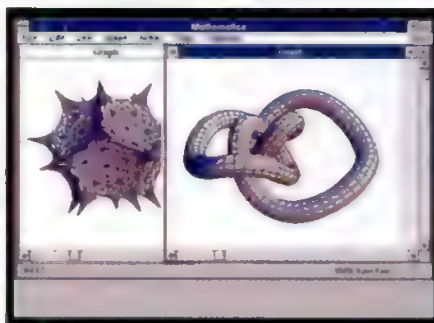
HANDS ON  
by Barry Green

With the release of *Mathematica*, Version 2.0 for Windows (\$995), Wolfram Research forever changes the standard of what's expected from programs that handle higher mathematics on the PC. The new user interface, based on a "notebook" front-end design, is more attractive and approachable than that of any other PC mathematical program except *MathCAD*. The underlying computational kernel is enhanced with loads of new functionality and improvements on existing features.

Describing itself as "A System for Doing Mathematics by

Computer," *Mathematica* sets a more ambitious goal than any other package in its class. Its core is symbolic manipulation, the term given to programs with two related abilities: exact calculations and computer algebra/calculus. The first ability implies the power to perform exact calculations with rational and real numbers to arbitrary precision. Ask *Mathematica* to calculate Pi to 500 places and it will give you the answer. The second ability means that the program can tell you functional derivatives and expand  $x + y$  to the 100th power.

*Mathematica* is not alone in its symbolic ability. Software-house's *Derive* and Waterloo



As this hyperbolic icosahedron and trefoil knot illustrates, *Mathematica's* graphical power is spectacular.

Maple Software's *Maple* were Editors' Choice winners in our roundup two years ago (see *PC Magazine*, May 29, 1990), and *MathCAD* has recently added limited symbolic manipulation. But *Mathematica* goes beyond the competition by integrating dramatic graphics, offering sound capability, and expanding the scope of its programming language. *Mathematica* also runs on Mac, NeXT, and even Cray platforms,

with each version's front end sharing a common kernel and commands.

The system requirements to run *Mathematica* are substantial. It needs a 386/387 processor combo or a 486DX and runs only in Microsoft Windows 386 Enhanced mode. It also needs a minimum of 13MB of real or virtual RAM. Since some of this memory could be in a disk-based

CONTINUES ON PAGE 44



# Compaq, Dell, and Zenith 386SL Notebooks Promise Longer Battery Life

## Compaq LTE Lite/25

HANDS ON  
by Matt Jones

With its Compaq LTE Lite/20 and LTE Lite/25, Compaq has trimmed half an inch in thickness and nearly 2 pounds in weight from the form factor of the LTE 386s/20. These 6-pound, 1.75-by-8.5-by-11-inch (HWD) 386SL-based laptops also improve significantly upon their venerable LTE predecessors in most other respects, including the keyboard and 16-shade VGA display.

Unfortunately, squeezing more into a smaller package required a few trade-offs on Compaq's part; most of these involve battery capacity.

List prices for Compaq's two new notebooks begin at \$2,899 for an LTE Lite/20 with a 40MB hard disk and \$3,699 for an LTE Lite/25 with a 60MB hard disk. Our test unit, an LTE Lite/25 with an 84MB hard disk, carries a list price of \$4,199. All of the 2.5-inch Conner Peripherals disks are rated at 19 milliseconds.

Aside from their processor speeds—20 MHz for the Lite/20 and 25 MHz for the Lite/25—the two machines differ in few respects. Both boast an upper limit of 10MB of memory, but the Lite/20 comes with 2MB RAM standard and the Lite/25 with 4MB. The Lite/20 ships with an enhanced nickel cadmium battery pack. The Lite/25 features a nickel metal-hydride (NiMH) version, which promises about 30 percent more capacity. The two batteries are interchangeable; Compaq sells both types optionally.

Similarities between the LTE Lite/20 and Lite/25 include a 1.44MB floppy disk drive as standard equipment and support for Compaq's \$599 9,600-bps internal modem, its existing desktop expansion base, and the newly enhanced \$929 version. Each also accepts a 387SX math coprocessor of the appropriate speed—20 or 25 MHz.

Compaq's new keyboard is among the more welcome im-

At 6 pounds, the Compaq LTE Lite/25 is both smaller and lighter than the LTE models that came before it.



provements over past LTE models. At last, Compaq has abandoned its "L" arrangement of the cursor keys in favor of an "inverted-T" design.

If you've ever tried to keep track of a mouse pointer on an LCD screen, you'll applaud another of the more alluring enhancements: The 9.5-inch edge-lit supertwist LCD panel, developed by Citizen and Compaq, brings response time to a maximum, drastically reducing ghosting. Image quality also ranks with the best, thanks in part to Compaq's bright backlighting.

At long last, Compaq has added the capability to use the internal display and an external VGA monitor simultaneously, a must for screen-based presentations. A function key combination lets you choose: internal, external, or both running simultaneously.

Given that the success of past LTE models owed at least something to their superior battery

life—all tested at over 3 hours in past rundown tests—the 2 hour 34 minute performance of the Lite/25 is a disappointment, especially since Compaq is using a NiMH battery pack. The machine actually draws substantially less power than the LTE 386s/20, but Compaq reduced its battery from 1.7 to 1.2 pounds to help achieve the 6-pound overall weight.

As usual, PC Magazine Labs performed the Battery Rundown test with all power conservation features disabled.

Fortunately, Compaq has worked hard to tap the power conservation capabilities of Intel's 386SL chip set in a few ways that other manufacturers have not yet managed.

As with most laptops, the Lite/25 can power-down various components after a set period of inactivity, but Compaq has improved this capability through two features. In addition to a custom, user-set profile, Compaq's utilities provide three preset conservation profiles. Another pop-up window displays an estimate of how much longer the remaining charge will last at the current settings.

Compaq has taken advantage of two other underutilized capabilities of the SL chip set. In



## FACT FILE

**Compaq LTE Lite/25**  
Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269; 713-370-0670.  
**List Price:** Compaq LTE Lite/25 with 4MB RAM, 60MB hard disk, \$3,699; with 84MB hard disk, \$4,199; with 120MB hard disk (available in second quarter of 1992), \$4,699.  
Compaq LTE Lite/25 with 2MB RAM, 40MB hard disk, \$2,899; with 60MB hard disk, \$3,199; with 84MB hard disk, \$3,599.  
MS-DOS 5.0, \$99; spare NiMH battery pack, \$199; spare nickel cadmium battery pack, \$129; external battery charger, \$99.  
**In Short:** Despite somewhat lackluster battery life, Compaq's 386SL-based notebook portables squeeze power-user capabilities and minimal LCD ghosting into a 6-pound case.

CIRCLE 428 ON READER SERVICE CARD

addition to the familiar standby mode, which shuts off display backlighting, the disk drives, and numerous other components, the Lite/25 offers a Hibernation mode, which saves the state of the system to disk and then completely powers down the machine. The only drawback of the hibernation feature is the time needed to awaken the system: Resuming operation under Windows 3.0 took about 30 seconds.

Compaq also supports the ability of the SL chip set to alter the processor speed dynamically, though at this point the inactivity setting simply lowers the pro-

## PAUSES THAT REFRESH

by Christopher Barr  
and Don Willmott

Intel's 386SL processor promises to extend the battery life of portable PCs significantly, not by drawing less power but by being intelligent enough to power-down the memory, disks, modem, video, and ports when they are not in use. The results can be impressive, and when applications become smart enough to manage power as well, battery life will be extended even further.

Incorporating the 386 CPU, a cache controller, a memory controller, an AT-bus controller, and EMS 4.0 hardware, the 386SL is an extremely integrated chip. It contains 855,000 transistors—more than three times as many as the 386SX—and that means that notebook designers should be able to keep both the size and the prices of their systems down as they design new models.

Zenith Data Systems, a



cessor speed to 3 MHz after a predetermined length of time.

A final feature related to battery management, the Compaqs' 1-hour recharge time, also ranks as an important advantage, though this owes more to Compaq's processor-equipped battery pack than to the SL chip set. The battery pack recharges in approximately 1.5 hours even with the machine in operation.

Compaq has unquestionably built two fine machines in its LTE Lite/20 and LTE Lite/25, despite their few drawbacks. The 6-pound Lite/25 would seem a prime candidate for the power-user notebook of choice, particularly for applications in which typical LCD ghosting would be a problem.

## Dell System 325NC

by Matthew J. Rose

Dell's System 325NC isn't the lightest notebook, or the smallest, nor even the least expensive. It doesn't even have the best color display: Passive-matrix is the lesser sister to the latest in active-matrix color portables. But with a price point around \$4,000, built-in floppy and hard disk drives, and dimensions roughly equal to a stack of three *PC Magazines*, the 7-pound System 325NC might just be the notebook for you.

What distinguishes the System 325NC from the competition is a more-than-adequate passive-matrix color display and a

set of impressive features with few compromises. Turn on the 325NC, and you'll see bright 640-by-480 VGA resolution in 16 colors, not the usual monochrome you would expect from a notebook's LCD. Dell's standard \$3,999 offering features an Intel 25-MHz 386SL processor, 4MB of system RAM (expandable to 12MB), a 60MB Conner hard disk, and a 3.5-inch floppy disk drive. Dell also offers an 80MB hard disk model for \$4,299 and plans to offer a 120MB hard disk version this spring. Also in the works is a high-speed 9,600-bps fax/modem. Dell currently offers a \$299, 9,600/2,400-bps fax/modem. It hopes to have the new hard disk and modem ready by April.

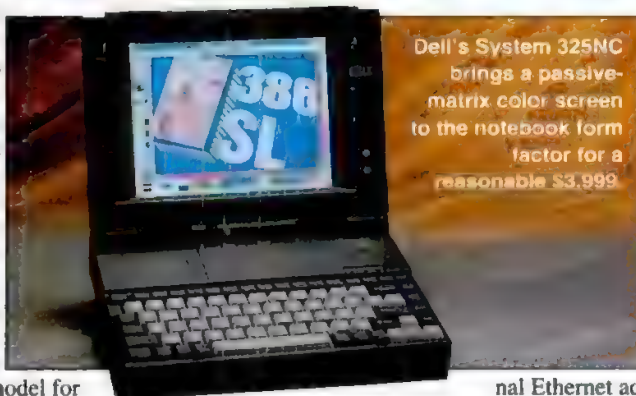
But the story remains affordable and attractive color in a notebook PC. The System 325NC performs well under Windows 3.0; good news for all of us who have struggled with Windows apps on portables having less than ideal monochrome LCDs.

While the passive-matrix color display is not as sharp as active-matrix, Dell has brought color to the notebook market for thousands less than the \$5,999 NEC UltraLite SL/25C (First Looks, January 14, 1992). The System 325NC is even competitively priced with the Compaq and ZDS monochrome SL-based systems reviewed here, and at 2.4 by 8.5 by 11 inches, it is only slightly thicker.

The high-contrast passive-matrix display measures 9 inches diagonally, and it fills the entire screen for both text and graphics. The edges of the display tend to wash out due to the close proximity of the fluorescent tubes that backlight the LCD, but color is vivid and even. We're all used to working with color, so Dell's passive-matrix LCD outperforms any monochrome display—particularly under Windows.

The System 325NC, like Compaq's Lite/25, uses a NiMH battery. Its AC adapter looks like a sleek European foil shaver and weighs 0.9 pounds, which gives

you an 8-pound travel package altogether. Our rundown tests reported a battery duration of 2 hours 27 minutes—which is respectable for a color notebook.



but you can expect even better battery life if you use the System 325NC's power-saving features. The NiMH battery was slightly erratic at first, but after we conditioned the battery by discharging and recharging a few times, its performance improved.

The 325NC's handiest battery option, its AC Time-Out Override, lets you disable all conservation techniques whenever the system senses AC power. With this option set, LCD and hard disk shutdowns only occur when the unit is running on its own battery power. Other handy SL-related power-management features include CPU speeds of 3, 6, 12, and 25 MHz, a global suspend mode that works even in Windows' 386 Enhanced mode, and a 2-minute reserve battery that lets you change battery packs in the midst of any application without loss of data. Battery recharge time is roughly 3.5 hours.

Another exciting feature in the Dell 325NC is the enhanced parallel port (EPP), which is also present in Zenith Data Systems' MastersPort 386SLe. EPP support is built into Intel's 82360SL I/O subsystem chip, and it allows SL-based PCs to burst data across the port for faster transfer rates than standard parallel ports. Peripherals connected to the parallel port require an EPP-aware driver to improve throughput. Expect new laser printers to be among the first devices that take advantage of the EPP.

To test the EPPs, we connected both the System 325NC and the MastersPort 386SLe to a NetWare network with a 33-MHz

386 server. Using Xircor's Pocket Ethernet Adapter II and a preliminary EPP software driver, we achieved a total transfer rate of 1.59 megabits per second from both the Dell 325NC and the MastersPort 386SLe. Using Xircor's previous driver (which does not recognize the EPP), the notebooks transferred data at 0.74 Mbps, a typical rate for standard external Ethernet adapters.

While Xircor has more than doubled its throughput using the EPP, the company hopes its final driver (to be released in March) will match performance speeds currently attained only by internal 8-bit Ethernet adapters. For now, though, Dell will not be providing drivers to support the EPP's data burst mode on its external tape and 5.25-inch floppy disk drives.

Unlike Compaq, Dell has fully loaded its SL-notebook with a 64K, four-way, set-associative cache, enough to give the System 325NC a slight performance boost over the Lite/25.

My only complaint with the notebook's design is the position of the floppy drive on the unit's right side, where most users will attach the BallPoint Mouse.

This minor complaint aside,

CONTINUED ON PAGE 40

codeveloper of the chip's power-saving talents, was the only manufacturer to come out with a machine based on the first 386SL chips produced. The second generation, or B-step chip, solves problems associated with the first chips. Now more than 40 vendors, including Compaq and Dell (whose notebooks are evaluated here along with Zenith Data Systems') have plans to build 386SL machines. ■

**FACT FILE**

**Dell System 325NC**  
Dell Computer Corp., 9505  
Arboretum Blvd., Austin, TX  
78759, 800-289-3355, 512-  
338-4400.  
**List Price:** With 4MB RAM,  
60MB hard disk, 1.44MB  
floppy disk drive, \$3,999; with  
80MB hard drive, \$4,299.  
Microsoft Mouse bundle  
(Microsoft Windows DOS 5.0),  
\$149; with Microsoft BallPoint  
Mouse, \$199; internal fax/  
modem, \$299.  
**In Short:** Dell's competitive  
price and good color  
performance are just two of  
many strong features found in  
its System 325NC.

CIRCLE 439 ON READER SERVICE CARD



## First Looks

Dell's System 325NC is a fast, affordable color notebook that makes hitting the road easier on the eyes.

## ZDS MastersPort 386SLe

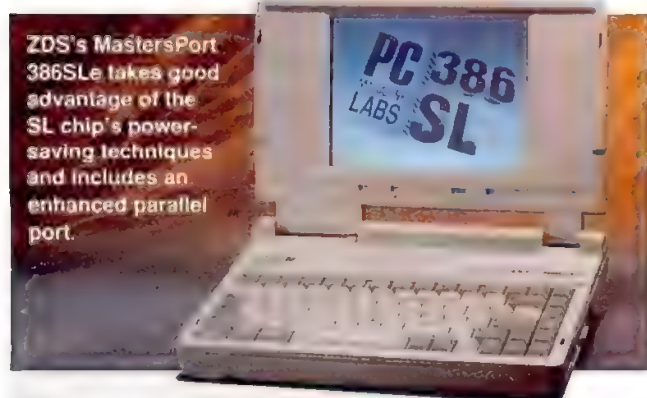
HANDS ON  
By John R. Quain

Like the Dell System 325NC, Zenith Data Systems' ZDS MastersPort SLe includes the 25-MHz 386SL processor as well as the enhanced parallel port. Even with dealer discounts of 20 percent off the \$3,999 list price, the MastersPort isn't the winner of this war, but it may be your ideal traveling PC.

With its battery and optional 2,400-bps MNP 5 internal modem (\$349), the MastersPort tips the scales at 7.1 pounds. Its 1.8-by-12.4-by-8.3-inch dimensions are not the smallest, but ZDS has designed its chassis to withstand rough treatment. You won't lose any flimsy port covers or pop the screen open by accident.

The \$3,999 price includes 2MB of DRAM, a 64K cache, an 85MB Conner hard disk, an internal 1.44MB floppy disk drive, flash BIOS, and a power adapter/battery charger. Connections include an enhanced parallel port (EPP), a serial port, a VGA port, a PS/2 mouse port, and a floppy disk drive connector.

In PC Magazine Labs' tests, conventional memory access was bolstered by the 64K external cache, posting times superior to 386SX systems. Though the 85MB Conner hard disk isn't unusually fast, it is able to suspend operation even when running Windows 3.0 in Enhanced mode.



ZDS's MastersPort 386SLe takes good advantage of the SL chip's power-saving techniques and includes an enhanced parallel port.



## BENCHMARK TESTS: COMPAQ LTE LITE/25, DELL 325NC, ZDS MASTERSPORT 386SLe

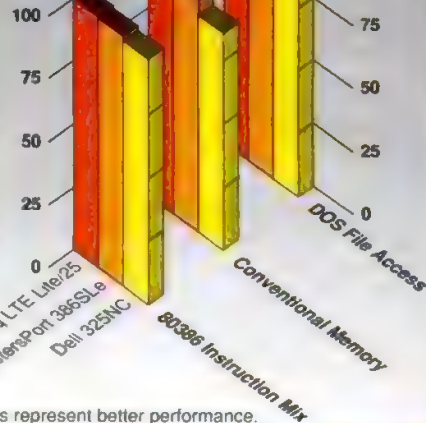
The Dell 325NC turned in the best performance of the 25-MHz 386 SLs reviewed here, but all three machines did well; performance differences were minimal.

■ The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

■ The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower times can indicate the presence of memory wait states or memory chips rated at relatively slow access speeds.

■ The disk score is the sum of the small-record and large-record **DOS File Access** benchmark test times. Each test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. No software cache is employed.

Relative Times  
(Compaq LTE  
Lite/25 = 100)



| Elapsed Time (seconds)<br>(Lower scores represent<br>better performance.) | 80386<br>Instruction<br>Mix | Conventional<br>Memory | DOS File<br>Access |
|---------------------------------------------------------------------------|-----------------------------|------------------------|--------------------|
| Compaq LTE Lite/25                                                        | 2.53                        | 0.42                   | 50.32              |
| ZDS MastersPort 386SLe                                                    | 2.51                        | 0.39                   | 51.49              |
| Dell 325NC                                                                | 2.46                        | 0.36                   | 48.66              |

For power management, there are two basic operating states: standby mode and rest mode. Standby mode enables users to specify the duration of inactivity (from 1 minute to 3 hours), after which the MastersPort will reduce power to the video subsystem, processor, and hard disk. Full power is restored by a touch of the keyboard.

In rest mode, everything but the memory subsystem is shut down. This mode, which can be invoked by hitting the power button or set to occur automatically after a period of inactivity (also from 1 minute to 3 hours), is intended to supplant having to reboot the system. ZDS claims the MastersPort can remain at rest for several weeks. A touch of the power button brings the system back to life—even in the middle of a Windows application.

If the battery dies while in rest mode—or you ignore the low-power warning beeps while

using the MastersPort—the system saves all your data before powering down. An internal backup battery will retain your data for approximately six days.

In PC Labs' Battery Rundown test the MastersPort put in a time of 2 hours 53 minutes. That places it slightly better than the Compaq notebook, but off the mark of more than 4 hours set by the expensive AT&T Safari.

The second salient feature of the MastersPort is its EPP. The EPP will offer a significant increase in throughput across the port to peripherals whose drivers can support the EPP's burst transfer of data.

The MastersPort basically carries itself well, and the keyboard is good. There are 12 full-size function keys across the top, and separate Home, PgUp, PgDn, and End keys are aligned down the left side above the "inverted-T" grouping of cursor keys.

Security conscious IS managers will appreciate the MastersPort's two-level password protection. One level allows access to the PC's operating system but prevents the user from changing the system setup or configuration without a supervisor's permission and password.

The only weakness of the MastersPort 386SLe is its monochrome screen. It is bright enough but not big enough. The super-twist backlit LCD screen displays 32 shades of gray in VGA mode but is only 5.2 inches high and 6.8 inches wide (8.75 inches diagonally). But the overall feature mix and performance edge show that ZDS is paying attention to business users' needs. ■



## FACT FILE

### ZDS MastersPort 386SLe

Zenith Data Systems, 2150 East Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331.

**List Price:** With 2MB RAM, 85MB hard disk, 1.44MB floppy disk drive, power adapter/charger, \$3,999; 2MB RAM upgrade, \$399; 2,400-bps internal modem, \$349; send/receive fax/modem, \$499.

**In Short:** With the power management finesse of the latest SL Intel chip set, the potential of the enhanced parallel port, and a stalwart chassis, the MastersPort 386SLe should satisfy most corporate business travelers.

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## First Looks

### T6400DXC

CONTINUED FROM PAGE 37

parallel port, and ports for an external VGA monitor, a keyboard, and a mouse.

The T6400 has a clamshell-style laptop shape, measuring 4.1 by 15.4 by 10.5 inches (HWD). Gas plasma machines are 3.3 inches high. At 12.9 pounds (11.7 pounds with gas plasma display), the T6400DXC is comparable in weight to the earliest 8088/8086 laptops.

With the power supply built in (no external AC adapter is needed), all you have to lug around in addition to the laptop is a power cord. The keyboard is detachable, but if you leave it in place you can hold the T6400DXC comfortably in your lap and type away on a train if you find a seat with an AC outlet. Unlike some other laptops, the bottom of the T6400DXC does not generate heat that scorches your thighs.

The most impressive feature of the T6400DXC is the color screen. It's clear, bright, and has high contrast. There are no screen controls, but by tilting it you can change its brightness. The 256-color TFT active-matrix display

has a maximum 640-by-480 resolution and is comparable in speed to desktop monitors.

The \$2,750 premium for buying the color screen instead of the 16 gray-scale gas plasma display means you'll need good justification for color. The screen is bright and large enough that even if you use this system in one location, you may not be tempted to plug in a standard-size external monitor. Most people will only use the external VGA port to plug in huge monitors for group presentations. The external video port and the on-screen display can be used simultaneously.

The T6400DXC has a 101-key detachable keyboard with medium clickiness and a good feel. You can leave the keyboard in place or take advantage of its 2-foot cable to move it in front of the unit. Twelve function keys are located at the top, much like a standard keyboard, but the Ins and Del keys are on the top row, to the right of the F12 key.

In addition to the usual serial, parallel, and external VGA ports, there are ports for an external PS/2 keyboard and a PS/2 mouse. A 150-pin expansion-bus connector on the rear will accept standard third-party accessories.

Internally, in addition to the

two slots for memory cards, there is one 16-bit ISA full-length slot and a dedicated modem slot. Toshiba sells two 2,400-bps internal modems, one with standard protocols (\$199) and a second with MNP 5 and V.42bis (\$259).

Two Toshiba products now under development will enhance the T6400DXC's utility as a multimedia system. A Z-connector on the motherboard will take input from a special video card to display on the internal monitor. Toshiba is also preparing an internal CD-ROM drive to replace the internal floppy disk drive. (The latter option will be available during the second or third quarter of 1992.) Third-party audio boards can be installed in the internal expansion slot to add sound to presentations.

The system that is most similar to the T6400DXC is the new Compaq Portable 486C, which is also a 33-MHz 486-based AC-only portable with a 10.4-inch, 256-color TFT screen. The Compaq is a little bigger, a lot heavier, and somewhat more expensive (\$10,999 for the Compaq 486C with 4MB RAM and a 210MB hard disk; \$9,999 with a 120MB disk).

The Compaq has greater memory capacity (32MB maximum versus the Toshiba's 20MB),



## FACT FILE

### Toshiba T6400DXC

Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445.

**List Price:** With 4MB RAM, 200MB hard disk drive, 1.44MB floppy disk drive, 256-color TFT active-matrix display, DOS 5.0, \$9,749. Memory cards: 2MB, \$435; 4MB, \$699; 8MB, \$1,335. 2,400-bps Hayes-compatible internal modem, \$199; 2,400-bps Hayes-compatible internal modem with MNP 5, V.42bis, \$259. External 5.25-inch floppy disk drive, \$399; TD80 external tape drive, \$849.

**In Short:** Lighter and less expensive than the comparable Compaq 486C, Toshiba's flagship portable has an impressive active-matrix color display well suited for colorful presentations on the road.

CIRCLE 426 ON READER SERVICE CARD

two internal expansion slots instead of the Toshiba's one, an EISA bus rather than Toshiba's ISA bus, and numerous security features including a disk-locking password system that works even when the drive is removed. The Toshiba T6400 series' sole built-in security feature is a BIOS-level system password.

It's not likely that Toshiba or anyone else will sell lots of AC-only, relatively heavy, active-matrix color systems. Given the popularity of sub-\$2,000, 4- to 7-pound notebooks, and considering that passive-matrix color models can cost less than \$4,000, you really have to need the T6400DXC's high-level processing power, extra memory, interface card expansion capability, and the high contrast of the active-matrix color display to spend this much money.

For long-term remote assignments, for small or large group presentations, or as a desktop replacement for someone who wants to be able to move a whole system easily, the T6400DXC's high power and screen are appealing, even at the high price. The T6400DXC's convenient shape, relatively low weight, and aggressive price point make it a very attractive competitor in the high-power portable market. ■

## BENCHMARK TESTS: TOSHIBA T6400DXC



In CPU performance, the Toshiba T6400DXC falls slightly below both the current crop of 33-MHz 486 PCs and the Compaq Portable 486c, its closest competition in the portable market. Nor can Toshiba's enhanced Western Digital video chip set match Compaq's VGA performance.

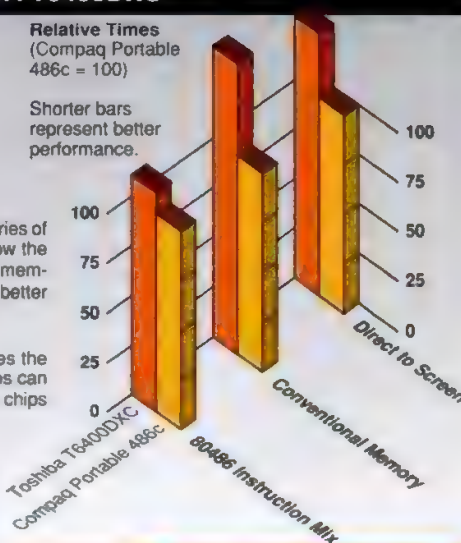
■ The **80486 Instruction Mix** benchmark test times a series of tasks specific to the 80486 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, faster times mean better overall computer performance.

■ The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower times can indicate the presence of memory wait states or memory chips rated at relatively slow access speeds.

■ The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. A good score indicates that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.

Relative Times  
(Compaq Portable  
486c = 100)

Shorter bars  
represent better  
performance.



Elapsed Time (seconds)  
Lower scores represent better performance.

|                      | 80486 Instruction Mix | Conventional Memory | Direct to Screen |
|----------------------|-----------------------|---------------------|------------------|
| Toshiba T6400DXC     | 1.22                  | 0.25                | 1.38             |
| Compaq Portable 486c | 1.10                  | 0.17                | 1.04             |







## Mathematica 2.0

CONTINUED FROM PAGE 37

swap file, you could, in principle, run *Mathematica* with only 2MB of RAM as long as you had 10MB of free disk space. But the program would go to disk so often that performance would be unacceptable. You'll want at least 6MB or 8MB of real RAM to get anything approaching acceptable performance.

### LIVE MATHEMATICAL PRESENTATIONS

The Windows version of *Mathematica* has what Wolfram Research calls a "notebook front end." Previously available only in Mac and NeXT versions, a notebook is a collection of various types of cells that build an interactive document. Cells can contain calculations, graphics, or text with a full array of support for Windows fonts and attributes, including *Adobe Type Manager* and True Type (under Windows 3.1). There are also *Microsoft Word*-type styles and a variety of bullets.

Cells can be formed into hierarchies, so that a notebook

by Barry Simon

The success of *Mathematica* is reflected in the number of books and third-party products it has spawned.

*The Beginner's Guide to Mathematica 2* by Theo. Gray and Jerry Glynn (Addison-Wesley, \$18.95, 800-447-2226) is written in a breezy and readable style geared to newcomers. A more thorough resource is Nancy Blachman's *Mathematica: A Practical Approach* (Prentice Hall, \$30, 800-922-0579). The defini-

ment all the text-handling capabilities of the other versions; each cell can have only a single font and a single attribute. Wolfram Research plans to include fuller font control and a ruler with drop-down style lists for the Windows front end of *Mathematica* 2.1.

*Mathematica's* graphical capabilities are outstanding. Not only can the program display curves, surfaces, and contours, but there are primitives for polyhedra, helices, and splines. You can write programs to

tive source for extensive coding is Roman Maeder's *Programming in Mathematica* (Addison-Wesley, \$35.50).

For an excursion through the world of mathematics using *Mathematica* as a tool, try Gray and Glynn's *Exploring Mathematics with Mathematica* (Addison-Wesley, \$34.50), which comes with a *Mathematica* notebook on CD-ROM with color and sound. Stan Wagon's *Mathematica in Action* (W.H. Freeman, \$39.95, 800-877-5351) delves more

deeply into primes and chaos. Richard Crandall's book *Mathematica for the Sciences* (Addison-Wesley, \$32.95) explores beyond pure mathematics.

A third-party package of *Mathematica* routines, *MathTensor* (\$500, 919-967-9853) has over 250 functions for general relativity and differential geometry. *Nodal* (\$395, 408-262-3575) is a collection of circuit analysis tools for electrical engineers. ■

### EXPRESSING FUNCTIONS AS SOUNDS

*Mathematica's* kernel now supports sound, but the Windows version does not ship with any sound drivers. A driver for the Sound Blaster is available from Wolfram Research, and a driver is under development for Microsoft Windows with Multimedia Extensions. With such a driver, *Mathematica* would be able to play a sound using a function as the sound amplitude, so a sine wave would produce a pure tone. It remains to be seen if the ability to express a function as a sound is more than a bell and whistle.

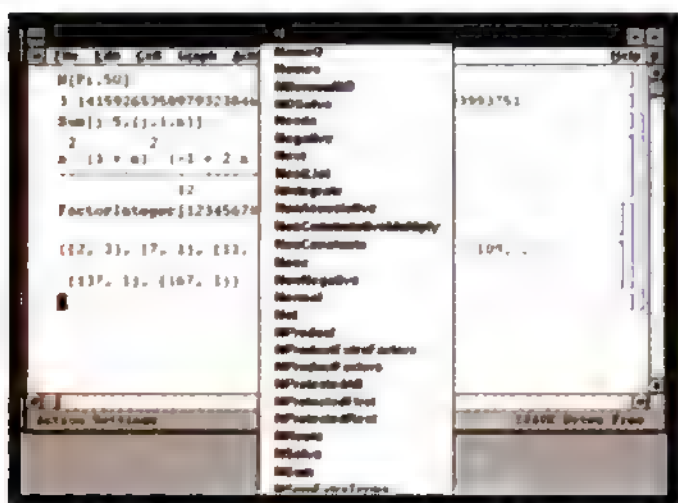
Wolfram Research has added hundreds of new functions to Version 2.0 and has strengthened existing functions. The program's symbolic integration routines now handle a number of integrals that previously could not be evaluated in closed form.

*Mathematica's* claim to being a general-purpose language is strengthened in Version 2.0. There are now string- and file-manipulation functions and a special trace mode that is unique to *Mathematica*. Trace mode makes the set of intermediate mathematical statements produced by *Mathematica* accessible so you can use the program's strong pattern-matching functions to focus in on the details behind a calculation.

While *Mathematica* is a wondrous program, it is not perfect. It was unable to evaluate

the integral that represents the gravitational potential of a ball correctly, and it seemed unable to evaluate some limits that other programs could get (although any symbolic program will fail to evaluate some sample limits or integrals). Performance was often slow when it went to disk for some program piece that it hadn't loaded previously, and Windows halted it with "C Runtime Error" many times during testing.

Users in scientific and financial communities with heavy-duty mathematical needs and heavy-duty hardware will want *Mathematica*, Version 2.0 for Windows, for its graphical power, integration, and ease of use. ■



Start typing a command then hit a hotkey for a menu of completions. *Mathematica's* abilities include higher-order reals, computer algebra, and factoring of large integers.

can also be thought of as a collapsible outline. The combination of outlining and text handling with embedded color graphics makes *Mathematica* a tool for presenting live mathematical documents. There's even a free runtime reader that you can use to distribute such documents.

Although *Mathematica* is not a full-fledged word processor, several books on the program have been written in the form of *Mathematica* notebooks on the Mac and the NeXT. The Windows version does not imple-

control graphical parameters and properties. For example, you could display a complex-valued function of a complex variable by showing a surface plot of the magnitude, with the argument represented by color coding. Or you could place a sequence of graphs into *Mathematica*, instruct it to animate the sequence, and watch the result of this dynamic process unfold before your eyes. There's also a new pop-up 3-D Viewport Selector that enables you to interactively rotate a 3-D graph.



**Mathematica, Version 2.0 for Windows**  
Wolfram Research, 100 Trade Center Dr., Champaign, IL 61820; 800-441-6284, 217-398-0700.

**List Price:** \$995; upgrade, \$125.

**Requires:** 386-based PC or better, 4MB RAM (6MB recommended), 13MB hard disk space, Microsoft Windows 3.0 or later, 80387 coprocessor.

**In Short:** No other mathematical software package comes close to the breadth of *Mathematica's* vision of what computer mathematics should be. Superb graphics and a clean user interface complement an extensive group of symbolic and numeric functions.

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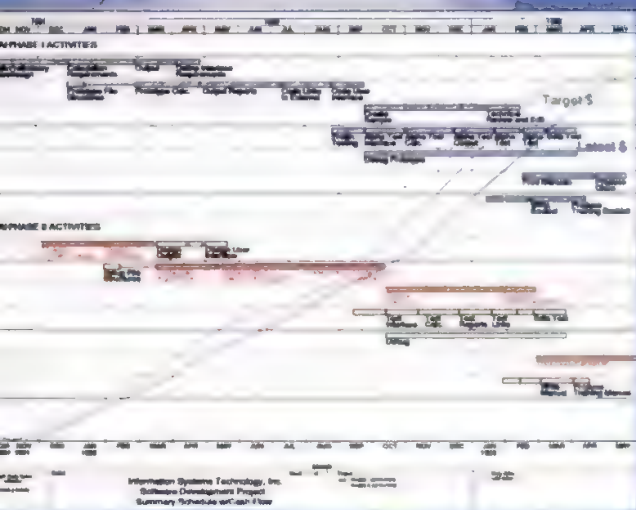
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# NEC Intersect 'M' Is Fastest CD-ROM Drive Yet

HANDS ON  
by Milt Jones

If you think you want a CD-ROM drive that meets the MPC performance specifications, think again: The NEC Intersect CDR-73M and 83M sustain a transfer rate of just under 300 kilobytes per second, twice the throughput called for by the MPC specifications and twice the rate sustained by the fastest of their competition. What's more, they do so at a competitive price: \$765 for the external CDR-73M and \$689 for the internal CDR-83M. Both models include a SCSI interface adapter.

NEC managed this transfer rate primarily through an ambitious divergence from the Yellow Book CD-ROM specification: Instead of spinning the platter to sustain a constant linear velocity of 75 sectors per second, NEC doubles the spin rate, to 150 sectors per second.

To ensure compatibility with Red Book CD-Audio data, which requires a strict adherence to the 75 sector per second linear velocity, NEC built code into the firmware that automatically slows the disk as necessary to read CD-Audio sectors. In other words,

Elvis won't sound like The Chipmunks if you don headphones and pop an audio CD into the Sony-built caddy. What's more, the drives maintain full compatibility with disks based on the High Sierra, ISO 9660, and Apple Macintosh HFS formats.

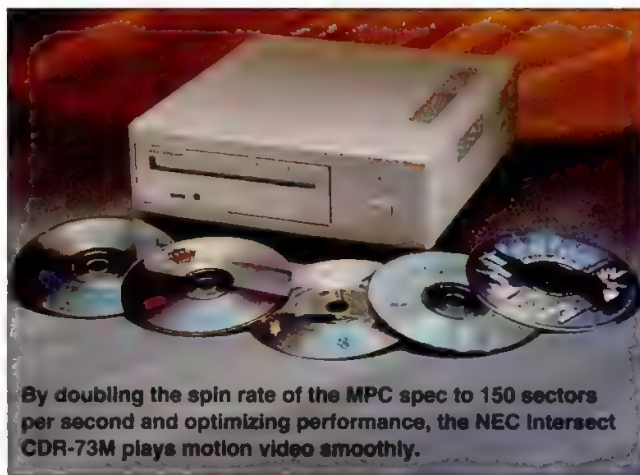
## M IS FOR MULTIMEDIA

NEC's latest two Intersect drives serve as replacements for similar Intersect models—the CDR-73 and CDR-83. Both also spin the disk at twice the traditional rate, but their firmware lacks the optimization needed to exploit the greater transfer rate fully and to best effect. When we last reviewed the CDR-73, for instance, we praised the drive for its top speed but criticized it for its jerky motion-video performance ("CD-ROM Drives: Finally Up to Speed," October 29, 1991).

To solve this problem and to boost the transfer speed of the subsystem, NEC reworked the firmware for these multimedia versions from the ground up. The results are impressive, to say the least.

Running on a rather slow 20-MHz 386 PC, the NEC CDR-73M we received for evaluation handled our motion-video tests with aplomb, eliminating the pause in the action required by its predecessor. PC Labs' benchmark tests run on the same system clocked the average sustained throughput rate for sequential reads across five record lengths at 287KBps. This easily tops the performance of the CDR-73, which averaged about 210KBps on similar tests during our recent CD-ROM roundup.

This performance is even more impressive when compared with that of NEC's competition. As one would expect given their 75 sector per second operation, the five MPC products that are reviewed in this issue's feature story on multimedia upgrade kits sustain a transfer rate of about 150KBps at their fastest (see "Do



By doubling the spin rate of the MPC spec to 150 sectors per second and optimizing performance, the NEC Intersect CDR-73M plays motion video smoothly.

Multimedia Upgrade Kits and PCs Meet the Challenge?").

The CDR-73M also performed smoothly with CD-ROM titles that include CD Audio. If the NEC's need to slow the platter causes a delay when the drive encounters CD-Audio data, the delay is certainly a trivial one and well worth the added performance that the higher spin rate affords.

## WHAT'S INSIDE

NEC lists the CDR-73M and 83M and their interface kits as separate products, and offers the drives themselves at list prices of \$675 and \$599, respectively. Given the difficulties involved with SCSI compatibility, most buyers will want to purchase an interface kit for their system as well, even if they already own a SCSI adapter. The \$90 XT/AT kit features an 8-bit Trantor T128 SCSI adapter. The PS/2 kit costs \$149.

Measuring 1.7 by 5.9 by 8.2 inches (HWD), the external chassis of the CDR-73M can occupy a good bit of desk space, but NEC has added a pair of plastic stands that allow the drive to be placed safely on its side. A power switch, power light, busy light, stereo headphone jack, and volume control adorn the front panel of the drive. Back-panel connectors include two RCA line-out jacks and two 50-pin SCSI connectors to allow daisy chaining. The power supply is switchable between 110 and 220 volts.

The XT/AT interface kit provided with our evaluation unit was comprised of the Trantor adapter, stereo earpieces, and the NEC/Trantor software: MSCDEX, the Trantor driver, and several

Trantor utilities, including *Music Box*. Though DOS-based, *Music Box* can be used to play audio CDs in the background within Windows 3.0 by initiating the play from a DOS partition.

## UPGRADE KIT ON THE WAY

NEC has provided numerous upgrade options, but the most important is its forthcoming MPC upgrade kit. The company has yet to set a price for the kit, which is scheduled for March availability, but has announced that each kit will include a CD-ROM drive, Windows 3.0 with Multimedia Extensions, an audio board designed for NEC by Media Vision, speakers, and headphones. Buyers who purchase the CDR-73M in the meantime will be offered the missing pieces for an undetermined price, as an upgrade.

Beginning in March, NEC will also offer a factory-installed upgrade to bring the CDR-73 and 83 up to the capabilities of the "M" models. Pricing on the upgrade has yet to be determined.

## IN ITS OWN LEAGUE

With its Intersect CDR-73M and 83M, NEC Technologies has taken a major step toward solving one of CD-ROM's most formidable problems: sluggish operation. The 280 millisecond average access time of these two models, though fast for CD-ROM drives, looks dismal compared with the 18 ms. or so you can expect from a hard disk, but you'll get better throughput from these two models than from most ST-506 hard disk subsystems. Other CD-ROM drives can't claim the same. ■

## PC FACT FILE

**NEC Intersect CDR-73M;**  
**NEC Intersect CDR-83M**  
NEC Technologies Inc., 1255  
Michael Dr., Wood Dale, IL  
60191; 800-632-4636, 708-  
860-9500.

**List Price:** CDR-73M  
(external), \$675; with XT/AT  
interface, \$765; with PS/2  
interface, \$824. CDR-83M  
(internal), \$599; with XT/AT  
interface, \$689; with PS/2  
interface, \$749.

**In Short:** These reasonably  
priced CD-ROM drives, one  
external and one internal, can  
perform at twice the transfer  
rate of the competition, putting  
these units in a class of their  
own.

CIRCLE 423 ON READER SERVICE CARD



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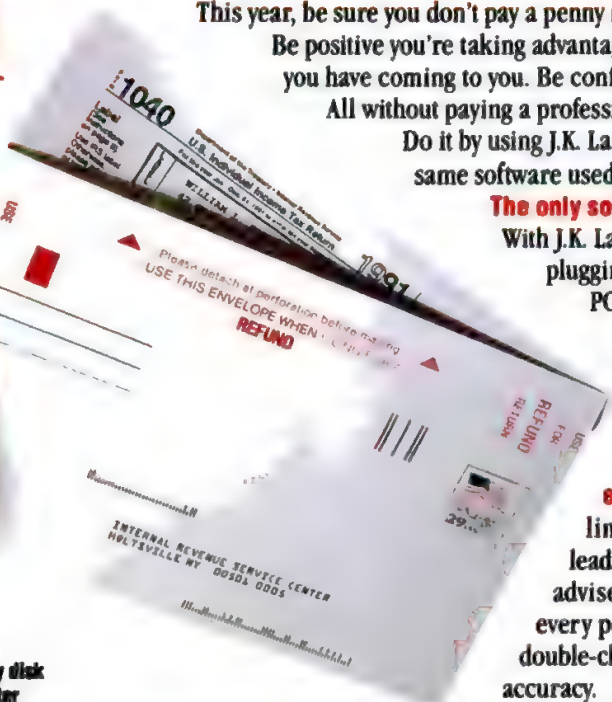
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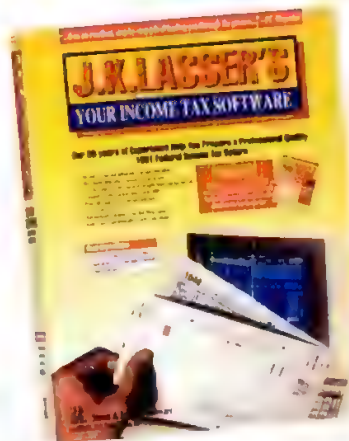
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## First Looks

# Arts & Letters Apprentice: Small Package, Big Talent



In drawing programs as in beer commercials, "lite" seems to be the latest trend. Following the lead of competitors such as Micrografx with its *Windows Draw*, Computer Support Corp. now offers *Arts & Letters Apprentice*, a stripped-down version of its high-end illustration program, *Arts & Letters Graphics Editor*.

For \$169, *Apprentice* gives you a full set of basic drawing capabilities but eliminates the sophisticated (and complicated) masking, tracing, text extrusion, object blending, and color separation features, which aren't of much interest to ordinary users.

Like its big brother, *Apprentice* has an interface that is something of an acquired taste but well worth learning. Unlike more conventional programs, *Apprentice* does not have tools for creating drawing primitives (rectangles, circles, and so on); rather,

you create such basic shapes by placing and resizing a huge array of symbols, from simple shapes on up to full-fledged pictures.

This approach has some real advantages. For instance, the ability to place three-dimensional-appearing boxes and prisms instead of creating them from scratch enormously speeds the tedious process of creating freehand diagrams and charts.

The resizable symbols are supplemented by a library of 3,000 high-quality clip-art images. You can select them by category and description using a clip-art manager.

*Apprentice's* superb set of line and Bezier curve drawing tools makes it the best in its class for freehand drawing. Creating curved shapes couldn't be easier: just sketch a rough outline and then fine-tune it by manipulating the nodes and control points. To create a closed object, you simply move the last node within a given distance of the starting point. There's also a rich lode of object ma-



*Arts & Letters Apprentice* is simple and easy to use, but it packs some powerful features such as customizable gradient fills and the ability to fit text to a curve.

nipulations, including slant, flip, duplication, and rotate tools.

The program's aggressive individualism gives it the freedom to do things better but also makes it a bit unpredictable. You can't get up to speed very easily simply by experimenting. You must take the time to learn the program's secrets. And you must keep the paper catalog of symbols close at hand. Though you can select many basic shapes from a scrolling list, most symbols must be called up by entering a number. Fortunately, the basic short tutorial is adequate, and innovative "mini-lessons"—self-documenting drawing files—let you practice with concepts as you learn them.

*Apprentice's* text handling is excellent. You must enter text in a pop-up box (or import it from ASCII files), but you can stretch the placement block before actually putting it down. This lets you eyeball it in one step rather than having to estimate a point size. The program comes with 25 outline fonts in all weights and styles, and it also supports the fonts supplied by your printer and Windows type managers. For a low-cost package, it has exceptional control over letter and word spacing.

Text on a curve is one of *Apprentice's* fancier features. Text remains editable even once it has been bound to a shape, and you have many options for placing and aligning letters. Another high-end feature is gradient fills, which you can customize in direction and repetition to just about any degree, though the more complicated patterns exact a price in performance. Color support is comprehensive, and you can edit and save your own color palettes.

As good as it is, *Apprentice* is made less attractive by the things it does not do. You cannot point-

edit basic symbols or break them apart in *Apprentice*, nor can you open up closed curves. Worse yet, though you can export your completed images to all the most common formats (including .CGM, editable .EPS, TIFF, .WMF, and .WPG), the only common import format is .WMF, and you can only place and resize such images—you cannot rotate them or break them apart and edit their elements. This limitation is deliberate; Computer Support Corp. recommends *Arts & Letters Graphics Editor*, at \$595, if you need to do this.

So while *Apprentice* may be the best tool for freehand drawing and putting together eye-catching clip-art compositions, its limitations render it unsuitable for the important task of editing images produced by other applications. It's a pity that you have no choice but to get Micrografx's *Windows Draw* if you're looking for an all-in-one solution. ■

## PICTURE WIZARD AIMS AT YOUNG USERS

"Get them while they're young," it's been said, and that's what Computer Support Corp. is trying to do with *Picture Wizard*. Like *Apprentice*, this is a simplified subset of the *Arts & Letters* graphics tools, but with a twist: Its clip-art collection is aimed at young people.

The program itself differs little from *Apprentice*; its page-sizing options are more limited and it has a fixed set of 126 colors instead of editable palettes. The real distinction comes in the collection of clip art and symbols, which consists of 1,000 images of airplanes, dinosaurs, cartoons, animals, and other pictures

of interest to home users. Even more innovative is *Picture Wizard's* "activities" manager, really a front end to a set of 95 sample drawing files that let you print out calendars, puzzles, banners, invitations, and other useful items. There are 16 typefaces, most of them lighthearted in style.

Since the basic program is not too difficult to master (and, like *Apprentice*, comes with a well-written manual), it's a suitable way to get children started on computer graphics. Adults will find it a useful storehouse of images and games. It's a clever idea, and, at \$89.95, worth the modest expense.—RM



### FACT FILE

*Arts & Letters Apprentice*, Version 1.0  
*Picture Wizard*, Version 1.0  
Computer Support Corp.,  
15926 Midway Rd., Dallas, TX  
75244; 214-661-8960.  
List Price: *Arts & Letters Apprentice*, \$169; *Picture Wizard*, \$89.95.  
Requires: 2MB RAM, 9MB hard disk space, Microsoft Windows 3.0.  
In Short: *Apprentice*, a talented little member of the *Arts & Letters* family, is rich in drawing features and is notable for its clean but eccentric interface. It's excellent for creating logos, diagrams, and freehand drawings, but its deliberate limitations in object editing and file import make it less useful than it should be.

CIRCLE 402 ON READER SERVICE CARD



## SQLBase 5.0: Database Server Supports NetWare/386, Multiple Partitions



The word "downsizing" has become a catch-all phrase to describe efforts by businesses to migrate applications from mini- and mainframe computers to PC-based LANs. In particular, it has come to represent the movement of large databases to client/server LAN systems. Until now, running a SQL database server meant having to use a proprietary, OS/2, or Unix-based system, regardless of the type of network operating system being used. It also meant generally limiting the size of the database itself to the maximum size of a single disk partition.

With the release of *SQLBase Server*, Version 5.0, Gupta Technologies has upped the ante in

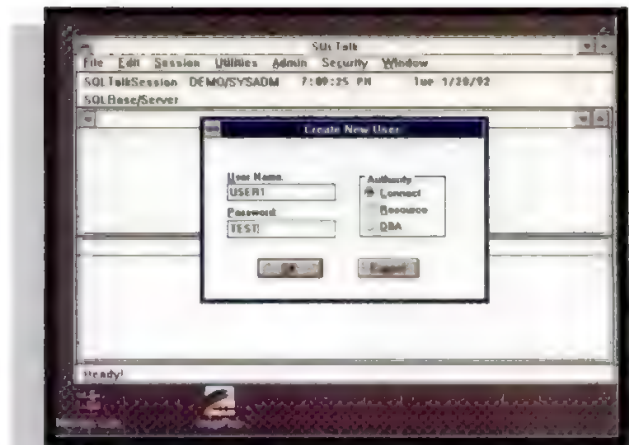
the race for the top spot among SQL servers by providing a system that runs as an NLM (NetWare Loadable Module) under Novell's *NetWare/386* 3.11 and has the ability to create databases that span multiple disk partitions.

Earlier versions of *SQLBase* ran on DOS, OS/2, and SUN OS-based networks (including *LAN Manager*, *LAN Server*, *VINES*, *3Com*, *3+Open*, and *NetWare* 2.11 or later), using NetBIOS, Named Pipes, or TCP/IP protocols to handle communications between clients and server. In addition to these operating systems, Version 5.0 comes in an NLM version that runs on a *NetWare* 3.11 or better system. It also adds the SPX/IPX protocols, an alternative to using NetBIOS as the transport mechanism. SPX database routers are provided for DOS, Windows, and OS/2 clients.

Unfortunately, the DOS router takes up 322K of RAM, severely limiting the size of applications that can be run with it. A utility is provided that removes the router from memory when it's no longer needed, and there's a version of *SQLTalk/Character* that includes the SPX router as part of its executable. (*SQLTalk* is Gupta's implementation of SQL and is compatible with the ANSI SQL language, with IBM's DB2 extensions.)

Another big improvement over earlier versions is *SQLBase* 5.0's ability to create a database that spans multiple disk partitions or volumes, increasing the maximum size of a database to a whopping 500 gigabytes. It achieves this through the use of storage groups to manage one or more database areas. (An area is a portion of the actual data that resides in a single partition or volume.)

Applications access the database using the storage group name instead of the actual area names;



*SQLBase* 5.0 comes with two interfaces—character mode and Windows. *SQLTalk/Windows* is the easier of the two for administrating and maintaining databases.

an area can be part of multiple storage groups as well. Space allocation in the different areas is handled automatically and can grow and shrink dynamically.

*SQLBase* 5.0 also offers enhanced referential integrity (RI). In the relational database model, RI means that the database management system ensures the validity and accuracy of any data contained in one table that refers to or is dependent on data in another table. Since RI has important implications for developers, the lack of RI in earlier versions of *SQLBase* was a source of criticism from potential users.

Gupta has implemented RI through the creation of foreign keys (indices) in the dependent tables that must be equal to and contained in a primary unique key in the parent table. SQL abilities that have been added to *SQLTalk* include the RESTRICT option to prevent deletion of a parent row if dependents exist, and the CASCADE option to automatically delete dependent rows when the parent is deleted.

Other improvements include the ability to create read-only databases, the addition of 32 *SQLTalk* keywords and 23 SQL keywords for full ANSI compatibility, and native support for a number of European and Asian languages.

Security has also been enhanced through the encryption of database and user passwords. Passwords are encrypted both on the server and prior to being transmitted from the client to the server.

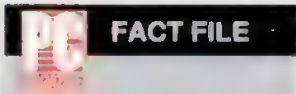
Installing the NLM version

on a *NetWare* 3.11 server was a simple 25-minute process. A number of NLM modules must be loaded first, though the process can be simplified by adding the load commands to the AUTOEXEC.NCF file or creating a separate .NCF to start the server. A status screen on the server's monitor shows who's connected to the server, what files are open, and a number of statistics to aid in tuning.

The *SQLBase* package includes both DOS and OS/2 versions of the *SQLTalk/Character* interface as well as the Windows-based *SQLTalk/Windows* interface. (You need Novell's Windows Client Workstation drivers for *SQLTalk/Windows* to work.) Both interfaces provide a simple way of administrating and accessing the database server through direct entry of *SQLTalk* commands.

The package includes a C/ API developers library to let C programmers create standalone applications that access the *SQLBase Server*.

Oracle is shipping an NLM version of its SQL server software and a Microsoft/Sybase version will be released this year, so those who are still in the planning stages of downsizing their systems will have a number of choices. The improvements in Gupta's *SQLBase Server* 5.0, particularly the NLM support, large database support, and addition of full referential integrity, as well as the number of alternative platforms it supports, make it a viable option for those considering a move to client/server architecture.



### SQLBase Server, Version 5.0

Gupta Technologies Inc., 1040 Marsh Rd., Menlo Park, CA 94025; 415-321-9500.

**List Price:** *NetWare* 3.11 version, \$4,995; DOS or OS/2 version (5 users), \$995; DOS version (unlimited users), \$2,995; OS/2 version (unlimited users), \$3,995; SUN OS (Unix) version, \$9,995.

**Requires:** For DOS: 2MB RAM, 10MB hard disk space, DOS 3.1 or later; For OS/2: 4MB RAM, 10MB hard disk space, OS/2 1.0 or later; For *NetWare*: 8MB RAM, 10MB hard disk space, *NetWare/386* 3.11 or later; For SUN OS: 4MB RAM, 10MB hard disk space, SUN OS 4.1.1.

**In Short:** *SQLBase Server* 5.0 becomes a viable alternative for downsizing large business databases through the addition of a *NetWare* Loadable Module (NLM) version to its multiple-platform support, as well as its increased referential integrity and ability to have databases span numerous hard disk partitions or volumes.

CIRCLE 422 ON READER SERVICE CARD



## FAXGrabber Performs OCR On Incoming Fax Images—Within Some Strict Limits

HANDS ON  
by David DeJean

Calera's *FAXGrabber* offers a fairy-tale promise: Faxes and PCs, which now coexist only awkwardly, will live in productive harmony. PCs with fax cards will receive faxes and *FAXGrabber*, like an elf making shoes by night, will automatically use optical character recognition (OCR) in the background to convert the big, bad fax image file—too big to store, too difficult to edit—into small, well-behaved text files.

This isn't entirely a fairy tale. *FAXGrabber* is shipping now for \$149. But the reality doesn't quite live up to the vision, because it pushes two technologies, optical character recognition and Windows 3.0, beyond their current capabilities.

The major problems aren't *FAXGrabber*'s. Calera knows OCR and Windows. Its *WordScan* and *WordScan Plus* OCR software packages put very usable Windows interfaces on a solid recognition engine.

*FAXGrabber* also runs under Windows and works with the

most popular flavors of fax boards from Intel, Fremont Communications, and The Complete PC, as well as boards that support Alien Computing's *FAXit* software. When an incoming fax is received, *FAXGrabber* can automatically pick up the file and convert it to text.

### LOW-PROFILE OPERATION

The program has next to no user interface of its own, just four icons that appear on the Windows desktop: one for *FAXGrabber* itself and three for "mini-apps" that queue fax files for other Windows applications.

■ A click on the Preview Queue icon will open Windows' Paintbrush or any other graphics application and feed it a fax image file. Cutting or copying a section of the file to the clipboard submits it to the recognition process. *FAXGrabber* works with a variety of graphics file formats: .DCX (a multipage .PCX format for document images), .PCX, .PDA, and TIFF.

■ Text files created by *FAXGrabber* can be queued for Windows Write or another text editor.

Clicking on the Postview Queue icon opens the editor and loads a file. (*FAXGrabber* can save text in nearly 60 different document, database, and spreadsheet formats.)

■ A Clipboard Queue icon works much like the postview function. Clicking on the queue's icon loads one document page from the queue into the clipboard so it can be pasted into a text document where you can edit it.

Cobbling together *FAXGrabber*'s user interface out of various existing pieces of Windows is an interesting idea. In some ways it works very well. The miniapps are easy to get the hang of, even if some commands are virtual state secrets. (For example, to start recognition processing after selecting a block to the clipboard in Paintbrush, you hold down the Control key and double-click the *FAXGrabber* icon. That one got left out of the product's manual.)

Not having a user interface of its own can make it hard to make major changes in *FAXGrabber*'s setup, such as switching from monitoring the fax board for incoming files to monitoring a subdirectory. That task requires digging parameter statements out of the manual and editing them into the program's .INI file, which is not something most PC users are used to doing.

### MULTITASKING POWER SHORTAGE

*FAXGrabber*'s biggest problem with Windows is mostly the result of misplaced enthusiasm: It really wants to be a multitasking application, doing what it does in the background while other things go on out front. Unfortunately, DOS and Windows just don't provide the horsepower. As a result, *FAXGrabber* is slower than standalone OCR packages, and when the recognition process is running, it slows down everything else going on in Windows as well.

*FAXGrabber*'s problem with facsimile technology is its poor resolution. Higher resolution means higher-accuracy OCR, and to be useful the accuracy of OCR has to be just about perfect. Misreading just one character in ten produces text that looks like chopped liver, and even one

### FACT FILE

**FAXGrabber, Version 1.0**  
Calera Recognition Systems Inc., 475 Potrero Ave., Sunnyvale, CA 94086, 800-544-7054; 408-720-0999.  
**List Price:** \$149.  
**Requires:** 2MB RAM, 6MB hard disk space, Microsoft Windows 3.0. Fax boards supported: Intel Connection Co-Processor, SatisFAXtion, The Complete PC Fax 9600, CAS-compatible fax cards, Alien Computing's FaxIt, Freecom 96.  
**In Short:** A praiseworthy attempt to integrate optical character recognition into the handling of faxes, undercut by the low resolution of fax images and Windows' lack of real multitasking processing.

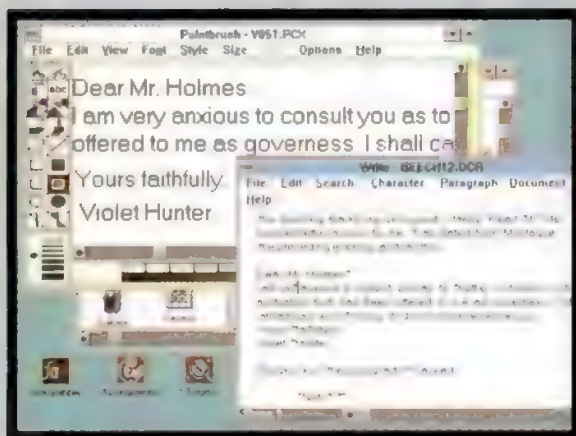
CIRCLE 425 ON READER SERVICE CARD

misread in 100 characters makes cleaning up the document by hand a necessity and a burden. The low resolution of faxes—200 by 100 dots per inch in standard mode, 200 by 200 in "fine"—makes 99 percent accuracy for the current generation of recognition engines nearly impossible to achieve.

### VARIATIONS IN SPEED

The simpler the document, the better *FAXGrabber* does with it. In our tests it turned pages of text laser-printed in 10-point Courier and transmitted in "fine" mode back into editable text at a rate of 90 words per minute. (This doesn't mean that it was never touched by human hands, but that the OCR process followed by manual cleanup and editing yielded text perhaps twice as fast as a typical typist.) *FAXGrabber*'s success rate depended primarily on the typeface and size of text in the transmitted document. A sample of 12-point Courier created from within Windows yielded text at the equivalent of 45 words per minute, and a sans serif face, 10-point Helvetica, yielded only 22 wpm. Samples of magazine pages with dense, small type in multiple columns yielded nothing intelligible at all.

The limits of Windows and of OCR technology limit the usefulness of *FAXGrabber*, but if the job is right, *FAXGrabber* can do what it promises. ■



*FAXGrabber*'s interface is limited to a few desktop icons. The OCR package supports fax cards and works in the background to convert fax images into editable text. It uses other Windows apps to display results.



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|-----------------------------------------|-----------------|-------------------|--------------------|
| <b>Most Powerful</b>                    | <b>Yes</b>      |                   |                    |
| Intelligent Graphs                      | Yes             | No                | No                 |
| Novell Network optimized                | Yes             | No                | No                 |
| Multiple sheets                         | Yes             | No                | Yes                |
| Multi-variable solver                   | Yes             | No                | *                  |
| <b>Easiest to Use</b>                   | <b>Yes</b>      |                   |                    |
| SpeedBar                                | Yes             | No                | No                 |
| Print-To-Fit                            | Yes             | *                 | *                  |
| Read Lotus 1-2-3 files, styles & macros | Yes             | Yes               | Yes                |
| <b>Best Performance</b>                 | <b>Yes</b>      |                   |                    |
| All features in 640K                    | Yes             | ?                 | No                 |
| Price                                   | \$495           | \$495             | \$595              |

? Yes, but almost no room remains for data.

\*Yes, but requires attaching an add-in.

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# B O R L A N D

Software Craftsmanship

<sup>1</sup>1991 J.D. Power and Associates® Computer End User Satisfaction Study: Phases I and III: Small to Medium-sized Businesses (responses from 1,784 business sites with 1 to 499 employees) and Large Businesses (responses from 1,094 business sites with 500 or more employees). Copyright © 1992 Borland International, Inc. All rights reserved. Pricing is in U.S. dollars. Offer good in U.S. and Canada only. Dealer prices may vary. BI 1471

CIRCLE 287 ON READER SERVICE CARD



## Carbon Copy for Windows Smoothly Runs GUI Apps by Modem

HANDS ON  
by Michael Conn

*Carbon Copy for Windows*, the latest version of Microcom's modem remote-control program, faces the daunting challenge of running Microsoft Windows applications over a phone line. The \$199 package includes programs for both the local and remote sides of the connection, and when run over a high-speed modem link it achieves excellent speeds, allowing you to run Windows apps with hardly any pauses.

Screen updates appeared especially crisp when we ran *Carbon Copy* on a V.32bis modem connection at 19,200 and 38,400 bits per second. The program takes time to refresh the screen over a 9,600-bps link when you first go into remote-control mode, but it's mostly smooth sailing after that (at least, as smooth as Windows ever gets). It even managed to display a complex *ImagePrep* graphics file in about 10 to 15 seconds over the 9,600-bps connection.

File transfers also go quickly. *Carbon Copy for Windows* displays a split-screen view of the host and guest drives, with directory trees at the top. Choosing files for transfer is a simple matter of pointing and clicking. The program managed to transfer a 150K text file in about 57 seconds over a 38,400-bps connection and in 1 minute 21 seconds over a 19,200-bps line. Its file-transfer speed compares favorably with most of the remote-control products we recently tested ("Productivity from Afar: Modem Remote-Control Software," February 25, 1992).

*Carbon Copy* includes an unusual option for cellular-phone connections. You can tell the program before calling that you will be accessing a cellular link, and it will automatically make its communications speed more flexible. The program features a

similar option for MNP 10 connections if the modems at both ends include Microcom's latest error-control protocol.

*Carbon Copy* takes security seriously, letting you password-protect your phone directory and prevent unauthorized access to your machine by remote users. You can also disable the host's keyboard and screen while at the guest side to prevent others from watching your moves or acci-



Running over high-speed connections (at least 9,600 bps), *Carbon Copy for Windows* lets you access Windows applications from a distance.

dentally rebooting while you're running an application.

The main drawback is that it does not give you full access to your DOS applications. You can only run them if you are running Windows in 386 Enhanced mode. For the most part, though, *Carbon Copy for Windows* offers an effective way to access Windows

applications remotely.

**List Price:** *Carbon Copy for Windows*, Version 1.0, \$199.

**Requires:** 1MB RAM, Microsoft Windows 3.0 or later. 9,600-bps or faster modem recommended. Microcom Inc., 500 River Ridge Dr., Norwood, MA 02062; 800-822-8224, 617-551-1000.

CIRCLE 403 ON READER SERVICE CARD

## RightWriter for Windows: Works Smarter, Gains Ground on Grammatik

HANDS ON  
by Rubin Rabinovitz

If you're a *RightWriter* fan who's been frustrated by the program's inability to do interactive grammar-checking, help is on the way. Que Software's *RightWriter for Windows*, Version 5.0 (\$99.95), includes a well-designed interactive editor that supports on-screen grammar checks and corrections. It has an attractive interface with pull-down menus that make it simple to edit documents, modify style settings, and change scan options. In addition, you can still do the old type of grammar-checking that produces marked-up documents with suggestions for corrections.

*RightWriter for Windows* installs easily, and its well-writ-

ten manual and helpful tutorial will have you up and running in a short time. A new three-level, context-sensitive help feature lets you choose the amount of help you need for a specific problem. Once the program completes its scan, it reports on such factors as readability, stylistic strength, and the use of jargon.

Other welcome enhancements include bookmarks, the ability to work with specified blocks of text as well as your entire document, and automatic rechecking of text after you've made emendations. When you complete a correction, the Replace button becomes an Undo button—a nice touch. Unlike some rival programs, *RightWriter* lets you back up to a previous line if you change your mind about a correction. A parsing-tree utility cre-

ates sentence diagrams like those you may recall from high-school grammar classes; this makes the program a valuable learning aid.

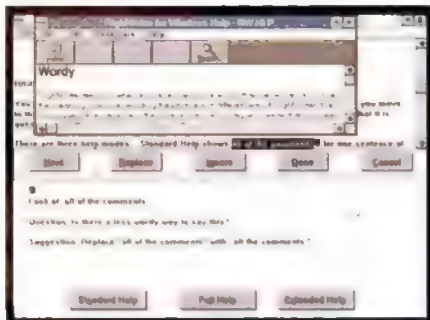
*RightWriter for Windows* supports Microsoft Windows Write. Running a simple setup routine adapts it to *Ami Pro*, *Word for Windows*, or *WordPerfect for Windows* so you can go directly into grammar-checking from these word processors' menus. *RightWriter for Windows* also works with ASCII and .RTF files, with text imported from other programs via the Windows Clipboard, and with documents created by over two dozen DOS-based word processors.

The program's ability to pick up punctuation errors is at about the same level as the DOS version (*RightWriter* 4.0). But a lot of style rules have been added to the Windows version, and these have improved the program's ability to detect grammatical errors and avoid false flags. *RightWriter for Windows* is a clean, good-looking program that has taken a long leap forward toward catching up with rivals such as *Correct Grammar*, *Grammatik*, and *PowerEdit*.

**List Price:** *RightWriter for Windows*, Version 5.0, \$99.95.

**Requires:** 286-based PC or better, 1.1MB RAM, Microsoft Windows 3.0 or later. Que Software, 11711 N. College Ave., Carmel, IN 46032; 800-992-0244, 317-573-2500.

CIRCLE 404 ON READER SERVICE CARD



*RightWriter for Windows* lets you see both your document and the suggested corrections. Its Extended Help window is equivalent to an on-line style manual.



# An open letter to dBASE users

From Philippe Kahn, Chairman of Borland



**I** am proud to announce dBASE IV® version 1.5, the first version of dBASE® since we acquired Ashton-Tate four months ago, is now available.

Version 1.5 is a faster, easier-to-use and more powerful version of dBASE. New features include mouse support, faster Query By Example data retrieval, 40 work areas, new BLANK support that lets you detect when fields are empty, open architecture Control Center, editable multi-file views, C language-like file I/O so dBASE programs can read and write files of any type, as well as other enhancements.

Borland has tested dBASE IV thoroughly. We stand behind it. In fact, to ensure your satisfaction, we'll guarantee you a complete, no-questions-asked refund, within 60 days of purchase if you are not totally satisfied.

What's next? We have several development teams working right now to build the latest technology into dBASE. For example, we will bring a dBASE compiler for Windows to market, which owners of the Developer's Edition will receive *free!* And we're putting this same technology into a DOS dBASE compiler. Of course, we will continue to enhance dBASE across platforms, including UNIX and VAX VMS.

I want to make sure that I get your feedback about our dBASE products. Call my Voicemail directly at 1-800-851-2122 with your critiques and suggestions. I'll personally make sure that your thoughts are taken into full account by our development team.

At Borland, we are committed to building the products you need. dBASE IV version 1.5 is an important, first step in the right direction.

Thank You,

P.S. You can order your upgrade now.  
Call 1-800-331-0877, Dept. 6304



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*Software Craftsmanship*

Corporate Headquarters: 1800 Green Hills Road, P.O. Box 660001, Scotts Valley, California 95067-0001, (408) 438-5300. Offices in: Australia (02-9539500), Belgium (02-4610448), Canada (416-2296000), Denmark (42-276455), France (1-34656000), Germany (06103-7680), Hong Kong (540-4380), Italy (2-2107292), Japan (03-54894867), Korea (02-5512795), Malaysia (03-2302618), Netherlands (020-5405400), New Zealand (09-8371266), Singapore (3998122), Spain (91-3883010), Sweden (8-7992000), Taiwan (2-7186627) and United Kingdom (0734-321150) ■ BI 1495  
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CIRCLE 295 ON READER SERVICE CARD



## Ascend: Windows PIM Follows Strict Time-Management Philosophy

HANDS ON  
by M. Keith Thompson

You may have tried many different PIMs over the years, both character- and Windows-based, only to find that each one falls short of its promise to organize your life. Though *PackRat* comes close, it is *Ascend* that will satisfy PC users who are truly dedicated to the goals of strict and efficient time management. From NewQuest Technologies, an affiliate of Franklin International Institute, *Ascend* is a Windows PIM based on the principles taught in Franklin's popular "Focus on Time Management" course.

*Ascend* is more than a software package. To reinforce its time-management techniques when you're away from your PC, NewQuest includes audio-cassettes of a time-management seminar as well as a Franklin Day Planner. The \$299 package also comes with a complete Day Planner filler with monthly index tabs, daily sheets for printing reports, and good documentation.

Designed around easy-to-use windows and dialog boxes, *Ascend* stores each type of information in its own window on the main program screen. These windows include Appointment Schedule, Address and Phone (with auto-dialer), Daily Record of Events, Favorite Quotes, Journal, Master Task list, Prioritized Daily Task list, Turbo File, and Values and Goals. Each of these windows plays an important role in the philosophy of effective time management.

The Prioritized Daily Task List is a glorified to-do list where you can include each item in order of importance. If you wish, you can designate tasks that are urgent as "A," tasks you can complete tomorrow as "B," and tasks that can wait as "C." But *Ascend* does not force its structure on users. If you want to, you

can list activities without assigning a priority level. The task list also provides a 64K notes field for attaching comments. For fast data access, you can assign a key field to an item and then later do a search on that key field. This searching technique is powerful; however, the Daily Task List allows you to assign only one key field to an item. (*PackRat* does not have this limitation.) You can also search globally on any text in *Ascend*'s infobase, but this search is slower than a key-field search.

*Ascend* handles the standard calendaring functions nicely. When you enter overlapping appointments in the Appointment Schedule window, the program informs you of conflicts and lets you continue. It also provides flexible scheduling options for recurring items. For example, you can enter an appointment for every third Thursday of the month or the last Monday and Friday of each month.

The Daily Record of Events window holds any notes you may want to record about meetings, appointments, and daily activities. You can enter up to 64K of

notes in this field. Like the other notes fields, the Daily Record of Events includes a few formatting commands, such as bold-face, underlining, and italics, and left, center, and right justification. You can also time- and date-stamp these notes.

Currently, you must enter your phone-call notes in the Daily Record of Events. A separate log that treats each phone call as a distinct entry with a notes field and key fields for searching would be an improvement.

*Ascend*'s Turbo File facility is a simple database designed to keep track of and organize snippets of information. There are fields for description, type of information, category, and location as well as a free-form 64K text area. You can find data quickly and easily by searching on any of the five key fields. Another practical enhancement would be for NewQuest to extend these key fields to the tasks and phone lists so you can find and group information from various windows. These lists are currently limited to one key field.

You can display any of the information you've organized in *Ascend* on-screen, and print out reports that are formatted simply and that are easy to read. The package comes with customized sheets for the Day Planner, and custom print settings let you print only the items you need. The program's label-printing options are also flexible.

Networked environments can



### FACT FILE

#### Ascend

NewQuest Technologies Inc.,  
2550 S. Decker Lake Blvd.,  
Salt Lake City, UT 84119; 800-  
877-1814, 801-975-9992.

List Price: \$299 with Franklin  
Day Planner, \$249 without; per  
user.

Requires: 2MB RAM, 2MB  
hard disk space, Microsoft  
Windows 3.0 or later.

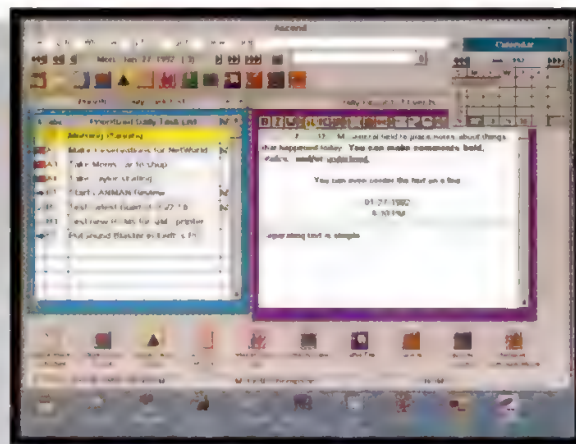
In Short: A well-designed  
Windows PIM based on the  
Franklin Institute's time-  
management principles.  
*Ascend* organizes your  
thoughts and tasks while  
maintaining flexibility for  
individual use.

CIRCLE 420 ON READER SERVICE CARD

take advantage of *Ascend*'s group scheduling and time-management features. Its network-independent design allows information sharing and communication among several types of network operating systems—including *LAN Manager*, *NetWare*, and *VINES* even when a user is not currently running *Ascend*. Network capability enables you to plan a meeting by first checking other users' schedules for conflicts and then booking the meeting in their appointment calendars. The program stores information in shared directories and includes password protection to prevent just anyone from changing your schedule.

NewQuest has designed *Ascend* with loads of practical features, but the company needs to move into the real world with its licensing policy. The *Ascend* licensing agreement covers only one user. If there are multiple users on one PC, you have to buy an additional license for each person. This licensing practice is unreasonable.

In every other respect, *Ascend* is an excellent PC implementation of Franklin's time-management program. It's a must for computer users who practice the principles taught in the program, and uninitiated users will find *Ascend* equally enjoyable to use without being forced to adopt every protocol. Whatever the condition of your current time-management regimen, *Ascend* will help you organize and prioritize your daily tasks, from start to finish.



*Ascend* provides several tools for managing time. You can use check marks to note the status of daily tasks and record comments in a separate window.





# How Borland's Paradox Is Making News in the USA . . . TODAY

USA TODAY® has changed the way Americans look at newspapers. As "The Nation's Newspaper," USA TODAY goes after critical, in-depth stories that affect people across the country.

But because many of those stories start with mountains of numbers and statistics, getting the facts is a difficult, time-consuming task. And in the deadline-oriented newspaper business, there is simply no time to waste.

To solve these complex problems, USA TODAY chose Borland's Paradox.®

## The Dawn of "Database Journalism"

USA TODAY's Special Projects Unit has the daunting task of gathering and analyzing various government reports and statistics to get to the important stories hidden underneath.

They call their work "database journalism," and Paradox is the tool of the trade.

Reporters download information—from census figures to campaign finance data to crime statistics—into specially created Paradox databases for easy searching and analysis. In many cases, Paradox imports these figures directly, since it reads dBASE® and Lotus® files.

## The S&L Scoop

In fact, Paradox and database journalism were key figures in USA TODAY's groundbreaking series of reports on the Savings & Loan crisis.

Early in 1989, USA TODAY's Special Projects

Unit used Paradox to investigate and analyze the health of more than 3,000 S&Ls across the country. As a result, USA TODAY readers were among the first to know about the national ramifications of this important story.

## A Messenger Called AMANDDA

USA TODAY has 29 bureaus and regional offices nationwide. The paper's production depends on all those offices sharing messages and vital information.

To handle this information flow, a system called AMANDDA (for Automated Messaging AND Directory Assistance) was created using Paradox to work with the corporate electronic mail system. This remarkable partnership links every USA TODAY office, and provides instant access to a variety of information sources, the lifeblood of a daily newspaper.

And with Paradox, AMANDDA was up and running in less than two months.

## Just the Facts

Paradox has all the powerful database features you need. Features like superior single- and multiuser access. Query By Example (QBE) to simplify finding the information you're looking for. Presentation-quality graphics for outstanding reports. The turbo-driven VROOMM™ system for maximizing memory use. Multi-table forms that let you look simultaneously at information from several tables. And that's only the beginning.

For developers, Paradox includes the comprehensive Paradox Application Language (PAL™). PAL puts the power of Paradox at your fingertips, and a set of robust development tools completes the programming environment. Exactly what you'd expect from a world-class database management system.

## Some Independent Opinions

Some of the most respected industry publications have also made Paradox their #1 choice.

"With its combination of speed, ease-of-use, and practical features, Paradox [is] an excellent value."

—Computerworld

April 8, 1991

"Paradox is an outstanding product for developers and end users. It's one of the finest combinations of programming and interactive environments available."

—InfoWorld

November 12, 1990

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## First Looks

# ImageQ Turns VGA Display Into Slide Presenter



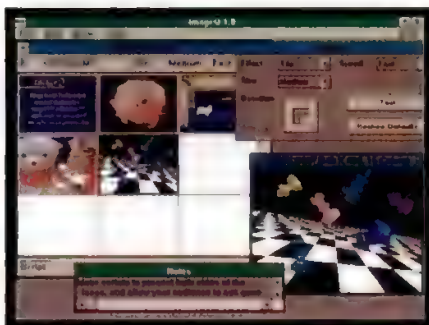
If you're tired of trusting important business slide presentations to the whims of slide projectors, you can rest easier with *ImageQ*. This \$349 presentation package from Image North Technologies replaces old-fashioned projected presentations by turning any VGA system running Windows into a screen-based slide projector. Unlike packages that concentrate on graphics creation and give short shrift to the mechanics of a presentation, *ImageQ* focuses almost exclusively on the show itself.

It takes advantage of Windows' powerful ability to display numerous 8-, 16-, or 24-bit true-color graphical images simultaneously. The program combines excellent image-handling capabilities with a power-

ful scripting language, and gives you the ability to create portable presentation files.

At the heart of *ImageQ* is its light-table metaphor and its extraordinary import flexibility. The program reads graphics files from a variety of sources (including .BMP, .GIF, .PCX, .TGA, and .WIN), and, without conversion, places them into sequence on the light table as thumbnail slides. You can then resequence slides or drag them to other open presentations. If you have directories full of images from which you'd like to pick and choose for use in a presentation, you can fill a light table with all the images (regardless of format), store them as a directory file, and display that file concurrently with the presentation you're constructing. Then just drag images from the directory to your presentation.

You can also easily cut and



*ImageQ* queues up graphics files and displays them as a slide show. Here a slide is shown along with speaker's notes and effects control boxes. The light table displays slide thumbnails.

paste text and graphics from any Windows application that supports the Clipboard. By assigning a "level" to each image in your presentation, you can cater to specific groups by displaying only images at a certain level.

A powerful presentation scripting language enables you to assign a variety of transitional effects, timing, and direction to individual slides. The language itself is rather arcane and you probably won't want to struggle with its intricacies. It's easier to use pull-down menu choices to automate script writing.

*ImageQ* can process any presentation to run standalone, making presentations portable. And, recognizing that files can become quite large, *ImageQ*

includes two file compression schemes. Even so, you'll have to make your files small enough to fit on a floppy disk if you're not carrying a laptop from presentation to presentation.

In fact, as a post-production presentation tool, *ImageQ* may be hard to beat. Whether laptop-based or floppy disk-based, *ImageQ* presentations may herald the beginning of the end of your old projector.

**List Price:** *ImageQ*, Version 1.0, \$349. **Requires:** 386-based PC or better, 2MB RAM, Windows 3.0, VGA card. Image North Technologies, 180 King St. S., #360, Waterloo, Ontario, Canada, N2J1P8; 800-363-3400, 519-570-9111.

CIRCLE 406 ON READER SERVICE CARD

# Fonts-on-the-Fly: PCL 5 Fonts for WordPerfect And Any Printer



LaserTools' \$149 *Fonts-on-the-Fly* lets *WordPerfect* and *WordPerfect for Windows* users print on virtually any printer with the same scalable PCL 5 soft fonts that normally work only with the LaserJet III. If you already own a LaserJet III, *Fonts-on-the-Fly* can give you faster output that's better-looking than what you get from your printer's built-in fonts. It's the only package that lets earlier LaserJets and LaserJet-compatibles use the same fonts built into the LaserJet III, so different printers in the same office can produce identical output.

*Fonts-on-the-Fly* comes with 19 scalable typefaces that print at sizes from 0.25 to 200 or more points, depending on your printer; you can add any PCL 5 font released by Agfa or HP. The

program includes separate modules for use with DOS *WordPerfect* and *WordPerfect for Windows*. Like Adobe *Type Manager* and Bitstream's *FaceLift for Windows* and *FaceLift for WordPerfect*, both modules generate fonts inside your PC and send them to the printer as bitmapped images. (PostScript printers and the LaserJet III normally scale fonts inside the printer.)

Unlike *ATM* or *FaceLift for Windows*, *Fonts-on-the-Fly* works with *WordPerfect for Windows*' fast, flexible *WordPerfect* printer drivers instead of the slow, limited Windows drivers. Also unlike *ATM* or *FaceLift*, the current version of *Fonts-on-the-Fly* won't generate Windows screen fonts, but you can get matching on-the-fly screen fonts with HP's free *Intellifont-for-Windows*.

The module that works with

DOS *WordPerfect* can be run either as a command line program that loads *WordPerfect* and clears itself from RAM when you exit *WordPerfect* or as a 14K TSR. Either way, you get fast output, especially if you print with multiple point sizes and use a fast computer. With a 33-MHz i486, *Fonts-on-the-Fly* took only 25 seconds to generate a page with five sizes of CG Times on a LaserJet III; the same page took 36 seconds when printed with the CG Times built into the printer.

You can use PCL 5 scalable fonts without *Fonts-on-the-Fly* if you already have a LaserJet III, but you may want the package anyway for its additional fonts and its improved version of the CG Times scalable font that is built into the printer. The new version's hinting produces markedly superior output at small sizes, with greater consistency between small and large sizes.

The package includes a lucid guide to document design, a clear, witty manual, and effortless installation. For fast, compatible printing with *WordPerfect* for

both DOS and Windows, no other font product comes close.

**List Price:** *Fonts-on-the-Fly*, Version 2.0, \$149. **Requires:** LaserJet, ink jet, or dot matrix printer, 640K RAM, DOS 3.0 or later. LaserTools Corp., 1250 45th St., Emeryville, CA 94608; 800-767-8004, 510-420-8777.

CIRCLE 406 ON READER SERVICE CARD

**Garamond Halfbett**  
**Garamond Kursiv H**  
**Futura Bold II**  
**Courier** (scalabl  
**Courier Italic BO**  
**Univers Medium**  
**Univers Medium Ita**  
**Univers Bold Italic**  
**Univers Medium Condense**  
**Coronet**

This sample shows some of the 19 fonts supplied in *Fonts-on-the-Fly*. You can add *Intellifont* typefaces from Agfa or HP.



CIRCLE 079 ON READER SERVICE CARD



# THE ULTIMATE BUSINESS COMPUTERS

PERFORMANCE UPGRADABLE COMPUTER SYSTEMS FROM CLUB AMERICAN COMPUTERS, INC.

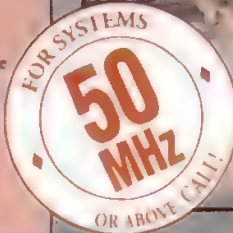
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- ◆ 64K cache RAM\*
- ◆ 4MB memory
- ◆ 120MB 16ms hard disk
- ◆ Video caching and shadowing
- ◆ Tower case available
- ◆ Performance 6.1 MIPS

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\$88.48/mo\*

### CLUB 386SX\*

- ◆ i386SX processor
- ◆ 2MB memory
- ◆ 50MB 17ms hard disk
- ◆ BIOS shadowing
- ◆ Small foot-print case

16 MHz \$1466  
\$55/mo\*  
20 MHz \$1541  
\$59/mo\*



**CLUB**  
American Computers, Inc.

ESTABLISHED 1986  
3401 W. Warren Ave.  
Fremont, California 94539  
HOURS: MON-FRI  
7:00 A.M.—5:00 P.M. PST

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All other products and their brand names are trademarks of their respective companies.  
PC, B, UL, CSA and TUV listed

\*256K RAM cache upgrade available. \*Based on Established Business, 36 month lease with 10% buyout. Payment may vary due to sales or use tax.  
†Not upgradable due to 16-bit system architecture

CIRCLE 238 ON READER SERVICE CARD



by  
Emerson Andrew  
Torgan

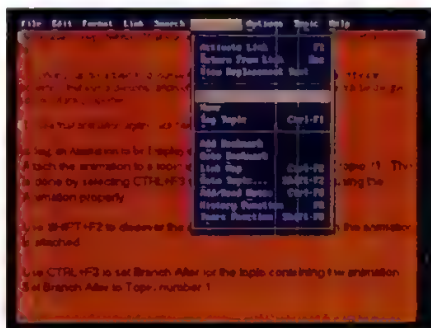
# New & Improved

News of Announced Products and Upgrades

## HyperWriter! 3.0: WYSIWYG Multimedia Authoring System

**IMPROVED** Ntergaid's new version of *HyperWriter!* adds a WYSIWYG editor with stylesheets, multiple on-screen fonts, and expanded multimedia support. According to the company, the authoring system features an extensive selection of color-coded links and full integration of text, graphics, audio, video, and animation.

*HyperWriter!*, Version 3.0, integrates *Hyper-Indexer* (previously available as an add-on) to add Boolean search facilities to its other navigation tools and link markers. Dialog boxes replace the scripting language of previous versions. The package's multimedia features let users create links to animation, videodisk images, and digitized sound. The new version supports .FLI file format animations from Autodesk Animator and the New Media



**HyperWriter!'s navigation tools let you jump to color-coded links in search of text, graphics, and action.**

Graphics Super Video Windows board.  
**List Price:** *HyperWriter!*, Version 3.0, \$495; upgrade from Version 2.5, \$129. **Requires:** 384K RAM, DOS 3.0 or later. Ntergaid, 2490 Black Rock Tpke., #337, Fairfield, CT 06430; 203-380-1280.

CIRCLE 408 ON READER SERVICE CARD

## HOT PROSPECT

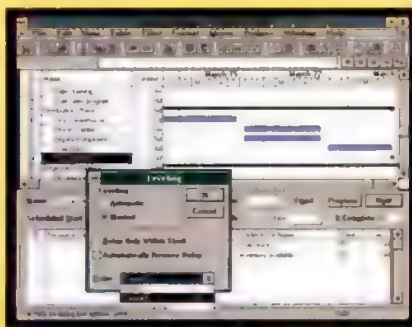
### MICROSOFT PROJECT FOR WINDOWS 3.0 STRESSES USABILITY, WINDOWS INTEGRATION

In an effort to make project management more attractive to anyone who needs to do general planning, Microsoft has added Planning Wizards (an interactive guide similar to the Page Wizards found in *Microsoft Publisher*), a multiple-page print preview, and customizable menus, charts, and toolbar to *Microsoft Project*, Version 3.0 for Windows. The new version also supports dynamic data exchange (DDE) and object linking and embedding (OLE), allowing data transfer and integration with applications such as *Excel* and *Word for Windows*.

Commonly used functions such as print, link, and unlink tasks now appear as buttons on the customizable toolbar. Users can rearrange the buttons, add or remove buttons, attach macros, and change button graphics with the bitmap editor.

Information is displayed in Gantt charts, tables, or in user-defined custom views and combinations. A multiple-page print preview accommodates large charts by letting users scroll both horizontally and vertically through up to 32 pages.

*Microsoft Project*, Version 3.0 for Windows' Planning Wizards orients users to tasks as basic as starting a project and acclimates them to more complicated functions. Planning Wizards functions interactively and can be called up throughout the program.  
**List Price:** *Microsoft Project*, Version 3.0 for Windows, \$695; upgrade from previous version, \$149. **Requires:** 2MB RAM, DOS 3.1 or later, Windows 3.0 or later. Mouse recommended. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 206-882-8080.



**Microsoft Project, Version 3.0 for Windows, lets users choose functions such as resource leveling from the toolbar.**

CIRCLE 407 ON READER SERVICE CARD

## MainLanEasy: Peer-to-Peer Network for \$200

**NEW** MainLan's peer-to-peer network starter kit ships with all the hardware and software required to connect two PCs. *MainLanEasy* includes two 4-megabit-per-second network adapter boards with terminators, 25 feet of cable, operating and diagnostic software, and Windows and DOS interfaces.

The MainLan kit is fully compatible with all DOS and Windows NetBIOS applications and lets users share files and peripherals. It supports file and record locking, offers password protection, and includes its own electronic mail. Additional adapters (\$99) allow network expansion to a maximum of six nodes. *MainLanEasy* does not require a dedicated file server. Additional offerings from MainLan include the *MainLan Ethernet*, *MainLan Windows*, and *MainLan/386* starter kits.

**List Price:** *MainLanEasy Starter Kit*, \$199.95. **Requires:** Nondedicated server, 50K RAM; workstation, 15K RAM; NetBIOS; one expansion slot per PC. MainLan, 1215 N. Hwy. 417, #135, Longwood, FL 32750; 800-999-6770, 407-331-4400.

CIRCLE 409 ON READER SERVICE CARD

## Dataproducts Unveils Low-Cost PostScript 2, B-Size Laser Printer

**NEW** Dataproducts has unveiled the LZR 1560, a PostScript Level 2 laser printer capable of handling paper sizes up to 11 by 17 inches. Designed to accommodate the need for large format printing in desktop publishing and CAD applications, the unit offers graphics output at a maximum resolution of 400 by 400 dots per inch.

Rated by the manufacturer at 15 pages per minute, the LZR 1560 features a Weitek 8200 RISC-based controller, 4MB RAM (expandable to 16MB), and 35 resident PostScript fonts. The printer ships with AppleTalk, RS-232, Centronics parallel, and SCSI (hard disk) connections. The LZR 1560 is available in single- (250 page), double-, and triple-tray models.

**List Price:** LZR 1560: single tray, \$5,695; double tray, \$6,495; triple tray, \$6,995. Dataproducts Corp., 6219 De Soto Ave., Woodland Hills, CA 91367; 818-887-8000.

CIRCLE 410 ON READER SERVICE CARD



## New & Improved

### BRIEFS



#### DESKTOP PCs

**Advanced Logic Research (ALR)** is shipping the \$995

PowerFlex Flyer 386SX/25 (\$1,049 with MS-DOS, Version 5.0, preinstalled), the first system based on Intel's new 386SX processor running at 25 MHz. The upgradable unit comes standard with 1MB RAM, a 60MB hard disk, and one 3.5-inch 1.44MB floppy disk drive. 800-444-4257, 714-581-6770.

**CompuAdd** is shipping two new 486-based PCs. The CompuAdd 420s (\$2,195), a 486SX running at 20 MHz, comes standard with 4MB RAM, a 40MB hard disk, a 5.25-inch 1.2MB or a 3.5-inch 1.44MB floppy disk drive, and a monochrome monitor. The CompuAdd 433 (\$2,995), a 486DX-based ISA machine running at 33 MHz, comes in a tower configuration with 4MB RAM, a 5.25-inch 1.2MB and a 3.5-inch 1.44MB floppy disk drive, an 80MB hard disk, and a monochrome monitor. 800-456-3116, 800-627-1967.

**Philips** is shipping two new Magnavox HeadStart PCs. The 386/20 XP (\$1,999) is a 386SX-based unit running at 20 MHz and comes standard with 5MB RAM, a 130MB hard disk, a 5.25-inch 1.2MB and a 3.5-inch 1.44MB floppy disk drive. The 486/20 XP (\$2,499) is a 486SX-based unit running at 20 MHz and comes standard with 5MB RAM, a 130MB hard disk, a 5.25-inch 1.2MB and a 3.5-inch 1.44MB floppy disk drive. Both models come preloaded with MS-DOS 5.0, Windows 3.0, PFS: WindowWorks, Q-BASIC, and Quicken for Windows. 800-722-6224, 213-217-1300.

**Micro Express** is shipping the ME 486SX/25 (\$1,999), a 486SX-based PC running at 25 MHz. The unit comes standard with 4MB RAM, 128K of RAM cache, an 80MB hard disk, a 5.25-inch 1.2MB and a 3.5-inch 1.44MB floppy disk drive. 800-989-9900, 714-852-1400.

**Commax** is shipping the 486-33T (\$2,495), a 486SX-based PC running at 33 MHz. The unit comes standard with 4MB RAM, 128K of RAM cache, a 120MB hard disk, a 5.25-inch 1.2MB and a 3.5-inch 1.44MB floppy disk drive. 800-526-6629, 408-435-5000.

CONTINUES ON PAGE 64

## Lotus Notes Adds DDE, Adobe Type Manager

**IMPROVED** Lotus is now shipping *Lotus Notes*, Version 2.1, with a new mail-enabling feature that lets users send electronic mail messages and attach files from within Windows applications. Using dynamic data exchange (DDE), users can send *Notes* mail from within all Lotus Windows applications such as *Ami Pro 2.0* and *1-2-3 for Windows*, or from any application supporting DDE that contains a macro or scripting language.

*Lotus Notes* has also expanded its support for Banyan's *VINES*, and includes a specific driver that offers users access to Banyan's native LAN and WAN communications protocols. The new version is bundled with *Adobe Type Manager*, Adobe's Windows font package, as a user-installed option.

**List Price:** *Lotus Notes*, Version 2.1, \$495 per node. **Requires:** Any NetBIOS-compatible network, Windows 3.0 or later. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-343-5415.

CIRCLE 411 ON READER SERVICE CARD

## Logicode Brings Style to High-Speed Fax Modems

**NEW** Logicode is shipping two external modems housed in a distinctive wedge-shaped Xeba case. The 9696XV is a 9,600-bps data modem that has 9,600-bps send/receive fax capabilities. The unit supports V.32, V.42, V.42bis data compression, and MNP 5 standard protocols. Using V.42bis data compression, the 9696XV is capable of throughput rates of up to 38,400 bps, according to the manufacturer. Several different file formats are supported for faxing, including ASCII, .BMP, .PCX, and TIFF.

The 14.4XV is an addition to Logicode's Quicktel 14,400-bps modem line and rated by



The high-tech Xeba case that houses Logicode's V.42bis send/receive fax modems can be positioned in a number of ways and is available in a black or platinum-gray finish.

the company as capable of throughput rates of up to 57,600 bps using V.42bis data compression. The modem supports V.22, V.22bis, V.32, V.32bis, V.42, V.42bis, and MNP 2 through 4 error correction. The 14.4XV is fully Hayes-compatible and supports the AT command set. Both units are available in internal versions.

**List Price:** 9696XV: external version, \$549; internal version, \$499. 14.4XV: external version, \$599; internal version, \$549. Logicode Technology Inc., 1817 DeHavilland Dr., Newbury Park, CA 91320; 805-499-4443.

CIRCLE 412 ON READER SERVICE CARD

## Persuasion Adds Runtime Slide Show Player, DDE, and OLE

**IMPROVED** Aldus is now shipping *Aldus Persuasion for Windows*, Version 2.1, which now includes the new *Persuasion Player*, a runtime application that lets users view and distribute *Persuasion* slide shows separately from the actual Windows application. *Persuasion Player* accepts and displays files created with *Persuasion 2.1* in either DOS or Macintosh file formats, and cross-platform file transfer is supported through 17 compatibility "AutoTemplates."

Version 2.1 also supports dynamic data exchange (DDE) for linking data, and object linking and embedding (OLE) for linking graphics. According to Aldus, operations performed in the outline view are accomplished faster, as is switching between slide and outline views. Twenty-eight new "AutoTemplates" are available, bringing the total to 83.

**List Price:** *Aldus Persuasion for Windows*, Version 2.1, \$495; upgrade from Version 2.0, \$50. **Requires:** 2MB RAM, Windows 3.0 or later, mouse or other pointing device. Aldus Corp., 411 First Ave. S., Seattle, WA 98104-2871; 206-622-5500, 206-268-2320 (upgrades).

CIRCLE 413 ON READER SERVICE CARD

## Open Plan Goes GUI, Adds PostScript

**IMPROVED** Welcom Software Technology has redesigned *Open Plan* with a new graphical interface. Version 4.0 of the project management package also features a new screen editor, PostScript support, additional report and code fields, and claimed performance gains in printing and on-screen drawing. Welcom's package sports the new "Project Executive" graphical user interface, allowing the user to input and view data from the WBS (work breakdown structure) view, the Project Network view, or the Barchart and Resource Histogram view.

In the WBS view, structures are built on-

CONTINUES ON PAGE 64



# Mobile *Networked* Computing.

The Link  
All Other  
Portable PCs  
Are Missing.



# All The Resource On The

## SAFARI® NSX/20 NOTEBOOK COMPUTER

"[Its] performance and userfriendly hardware and software features makes the Safari as close to perfection as you'll find today."  
*PC Laptop*,  
December 91

Battery life of up to 6 hours

DOs/Windows and  
AOL Mail loaded

Enhanced Mobile  
Communications  
through optional LAN  
adapter or integrated  
modem

Ready to use out of  
the box

"[The NCR 3125] is an intriguing pen-based 'notepad' computer that is truly ahead of its time."  
*The New York Times*,  
June 30, 1991





# s Of Your Office. Road.

## 3120 NOTEBOOK

High-resolution screen

Weights only 5.7 pounds

Compact Size (11.7" H  
x 11.7" W x 8.3" D)

Security—3 passwords  
accommodate three  
shifts of users

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and weighs less than  
4 pounds

### NCR is Putting It All Together With a New Generation of Mobile PCs Designed for Advanced Communications.

Mobile Computing is no longer a luxury, it's a way of life. But you need more than just mobility, you need connectivity. And that's something portable PCs haven't been able to easily give you. Until now.

NCR has combined the industry's most innovative portable technology with AT&T's worldwide connectivity to provide a new level of mobile computing. It's called Mobile *Networked* Computing, and it lets you network from anywhere in the world to anywhere in the world. Only found in NCR's powerful new family of portable PCs, it's the link all others are missing.

With an integrated modem or LAN adapter, the Safari® NSX/20 Notebook Computer is the first notebook PC designed specifically for networking, while still providing portability, ease of use, and the 386® SX power to run most any application. Plus, the Safari comes complete with the software you need for wireless E-mail and other communications facilities, including AT&T's advanced EasyLink® service.



NCR has also taken leadership in the notepad market with the System 3125™, a powerful pen-based computer which supports leading pen-based operating systems from GO Corp.™ and Microsoft.™

With its ability to automate handwritten forms, recognize graphic information and transmit it anywhere in the world via modem, the System 3125 can revolutionize the way your organization gathers and processes data.

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systems from GO  
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CIRCLE 242 ON READER SERVICE CARD



## New & Improved

### BRIEFS

CONTINUED FROM PAGE 60

**First Computer Systems** is shipping two new 486 PCs. The FCS 486-50 MHz (\$3,299) comes standard with 8MB RAM, 256K of RAM cache, a 200MB hard disk, a 5.25-inch 1.2MB and a 3.5-inch 1.44MB floppy disk drive, and a 14-inch SVGA color monitor. The FCS 486-33 Local Bus VGA (\$2,799) offers AutoCAD and Windows users the speed of a video controller on the processor bus, and comes standard with 8MB RAM, 64K of RAM cache, a 200MB hard disk, a 5.25-inch 1.2MB and a 3.5-inch 1.44MB floppy disk drive, and a 14-inch SVGA color monitor. 800-325-1911, 404-441-1911.

**Wang** is shipping the EXEC PLUS System 3127-1 (\$2,599), a 386SX-based multimedia PC running at 20 MHz. The unit is bundled with Creative Labs' Sound Blaster Pro audio board and CD-ROM MPC upgrade kit, a MIDI adapter/sequencer, and features pre-installed software including Compton's Multimedia Encyclopedia for Windows. Available through retailers only.



#### PORTABLE PCs

**Dolch** is shipping the P.A.C. 486-50E (\$8,898), an 18-

pound AC-only portable 486-based PC running at 50 MHz. The unit offers a gas plasma VGA-compatible display (optional active-matrix color display available) and comes standard with 4MB RAM, a 120MB hard disk, and a 3.5-inch 1.44MB floppy disk drive. 800-538-7506, 408-957-6575.

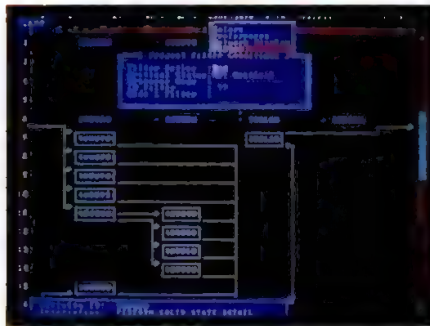
**Ergo Computing**, makers of the Ergo Brick, is shipping the NoteBrick (\$2,995), a 386DX-based notebook PC running at 33 MHz. The 8.7-pound unit comes standard with 4MB RAM, an 80MB hard disk, a 3.5-inch 1.44MB floppy disk drive, and a 9-inch, backlit VGA-compatible LCD screen. 800-633-1925, 508-535-7510.

**Micro Express** is shipping the NB913 (\$1,999), a 7.7-pound 386SX-based notebook PC running at 25 MHz. The unit comes standard with 2MB RAM, a 60MB hard disk, a 3.5-inch 1.44MB floppy disk drive and a 10-inch backlit VGA-compatible LCD screen. 800-989-9900, 714-852-1400.

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screen and linked to associated activities. In the Project Network view, activities can be grouped and relationships established with the critical path highlighted. The Barchart and Resource Histogram view displays each on the same screen. As activities are added, both views respond to the additional information.



**Open Plan's** new graphical interface lets users cut and paste groups of activities within the Project Network view.

**List Price:** Open Plan, Version 4.0, \$4,200. **Requires:** 640K RAM, DOS 3.0 or later, and a supported database (dBASE III Plus, Version 1.1, FoxBase Plus, or FoxPro). Welcom Software Technology, 15995 N. Barkers Landing, #275, Houston, TX 77079; 713-558-0514.

CIRCLE 414 ON READER SERVICE CARD

## AttiTools Windows Utilities Organize Your Information

**NEW** Attitash Software is now shipping AttiTools, Version 1.0, a collection of four Windows utilities designed to locate and organize information on local and network drives. The utilities offer file management, text search and retrieval, file launching, and analysis of disk space in use.

Attitash's Catalyst utility manages disk files, directories, subdirectories, and branches through a drag-and-drop method. Directories can be copied, moved, or deleted from the Catalyst directory tree. The utility works on both network and local drives.

The Dragnet utility offers full text search and retrieval for lost files in directories, branches, or across multiple network drives. Located files can be displayed through file viewers.

SlingShot and DiskSpace round out AttiTools. SlingShot provides an alternative file launcher to Windows' Program Manager and DiskSpace analyzes hard disk space utilization by file type.

**List Price:** AttiTools, Version 1.0, \$129.95.

**Requires:** 1.2MB hard disk space, Windows 3.0 or later, mouse or other pointing device. Attitash Software Inc., 20 Trafalgar Sq., Nashua, NH 03063; 603-882-4809.

CIRCLE 415 ON READER SERVICE CARD

## TeleMagic Pro Automates Sales

**IMPROVED** In its latest release, **Remote Control International** has added database maintenance features, TSR operation, and enhanced printer support to *TeleMagic Professional*, Version 12. By creating customer databases containing contact information and recording notes, *TeleMagic* functions as a telemarketing contact management package.

Version 12 now operates as a TSR with a pop-up calendar and meeting or critical-call alarms. *TeleMagic* also supports font changes as well as text highlighting in the package's word processing documents. Contact databases can be merged, and custom installation of additional users is accomplished with a new menu program. An electronic mail system is available in the network version of the package.

**List Price:** *TeleMagic Professional*, Version 12, \$495. **Requires:** 640K RAM, 3MB hard disk space, DOS 3.1 or later. Remote Control International, 5928 Pascal Ct., Carlsbad, CA 92008; 800-992-9952, 619-431-4000.

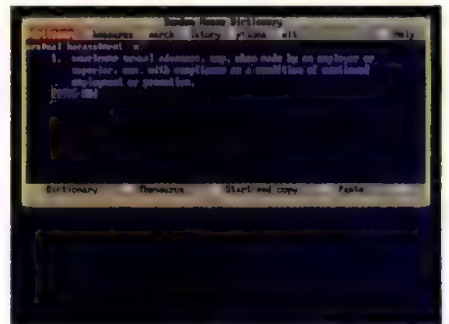
CIRCLE 417 ON READER SERVICE CARD

## Reference Software Puts 180,000 Words at Your Fingertips

**NEW** The Random House Webster's Electronic Dictionary & Thesaurus College Edition software package contains definitions for 180,000 words, more than 275,000 synonyms and antonyms, and occupies 9.8MB of hard disk space. The \$99 program functions as a TSR, popping up over most word processors. Both the dictionary and thesaurus can be invoked with user-definable hotkeys, and words can be pasted into the current document.

A "definition search" feature pulls up a list of words that are associated with a single key word. A wildcard search function lets users enter a string of letters with a ? or \* representing unknown characters.

CONTINUES ON PAGE 66



**Reference Software's** extensive dictionary includes definitions for sexual harassment and global warming.



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CIRCLE 091 ON READER SERVICE CARD



## New & Improved

### BRIEFS

CONTINUED FROM PAGE 64

**Commax** is shipping the Ultrathin (\$2,795), a 4.5-pound 386-based notebook PC running at 20 MHz. The unit measures 11 by 8.5 by 1.4 inches and comes standard with 2MB RAM, a 60MB hard disk, a 3.5-inch 1.44MB floppy disk drive, and a backlit 8.5-inch VGA DST paper-white LCD screen. 800-526-6629, 408-435-5000.

**Phillips** is now shipping its 6.4-pound LX320 notebook PC in standard configuration with an 80MB hard disk (\$3,799), 2MB RAM, a 3.5-inch 1.44MB floppy disk drive, and a 9.6-inch sidelit VGA-compatible LCD screen. 800-722-6224, 213-217-1300.



#### GRAPHICS BOARDS

**Hercules** is shipping the Hercules SuperStation 3D Model GB820 graphics accelerator board (\$2,995) with Windows drivers supporting 16-bit color at resolutions up to 1,024 by 768, and 24-bit color at resolutions up to 768 by 576. The upgradable single-processor board comes standard with 2MB VRAM. 800-532-0600, 510-540-6000.

**National Design** is shipping the AT600 (\$495) graphics accelerator board supporting 256 colors at resolutions up to 1,024 by 768. The board comes standard with AutoCAD and Windows drivers and 1MB VRAM. 800-253-8831, 512-343-5055.

**ELSA America** is shipping the XHR Gemini10 (\$1,275) graphics accelerator board supporting 256 colors at resolutions up to 1,024 by 768. 800-272-3572, 415-588-6285.



#### ANTI-VIRUS SOFTWARE

**Ontrack Computer Systems** is now shipping Version 5.53 of Dr. Solomon's Anti-Virus Toolkit (\$149.95), with a new detection methodology for "Stealth" viruses. 800-752-1333, 612-937-1107.

**Certus** is shipping NOVI (\$129), an antivirus package offering protection, detection, and eradication of all known viruses. Certus claims NOVI also protects against all unknown viruses and will need no updates. 800-722-8737.

CONTINUED FROM PAGE 64

**List Price:** Random House Webster's Electronic Dictionary & Thesaurus College Edition, Version 1.0, \$99. **Requires:** 6K RAM, 9.8MB hard disk space. Reference Software International, 330 Townsend St., #119, San Francisco, CA 94107; 800-872-9933, 415-541-0222.

CIRCLE 418 ON READER SERVICE CARD

## Microcom Puts High-Speed Modem In Your Pocket

**NEW** Microcom is shipping a 10-ounce, pocket-size portable modem capable of throughput rates of up to 38,400 bps on land-based lines. The MicroPorte 4232bis, a V.32bis unit measuring 4.5 by 2.75 by 1.5 inches, provides 1.5 hours of connection time on a fully charged battery.

Designed for data communications over LAN lines and cellular networks, the MicroPorte 4232bis supports MNP 10 for optimizing data transmission under poor conditions. (MNP 10 uses functions known as "Adverse Channel Enhancements.") Connections are made at 1,200 bps, then shifted up or down throughout the duration of the transmission to the highest possible speed the connection will allow. Line parameters are monitored throughout; packet size and modem speed are adjusted accordingly. The unit also supports MNP 2 to 4 error correction, MNP 5 and V.42bis data compression, and other modulation standards.



**Microcom's 10-ounce MicroPorte 4232bis is packed with sophisticated technology.**

**List Price:** MicroPorte 4232bis, \$899 (includes AC adapter). Microcom, 500 River Ridge Rd., Norwood, MA 02062-5028; 617-551-1000.

CIRCLE 419 ON READER SERVICE CARD

## Kodak Releases Portable Ink Jet Printer

**NEW** Eastman Kodak is shipping a portable ink jet printer that weighs 3.5 pounds with the unit's rechargeable batteries. The 2-by 10.8-by 6.5-inch (HWD) Kodak Diconix



**The Diconix 180si portable printer offers up to 50 minutes of continuous printing on fully charged batteries.**

180si is rated by the company at speeds up to 180 characters per second in draft mode.

The unit accepts either single-sheet or continuous-feed paper and attaches to any PC via a parallel or serial port. Windows 3.x drivers are supplied as well as IBM Proprinter and Epson FX-85 emulations.

**List Price:** Kodak Diconix 180si, \$399. Eastman Kodak Corp., 343 State St., Rochester, NY 14650; 800-344-0006, 716-742-4000.

CIRCLE 419 ON READER SERVICE CARD

## NetOp Adds Windows, Mouse-to-Mouse Support

**IMPROVED** Markham Computer Corp., the U.S. distributors of Denmark-based Danware Data A/S, has released NetOp, Version 3.0. The new version of the remote control package for LANs now includes support for Windows 3.x and remote mouse capabilities.

The package functions in both DOS and Windows environments, and includes a TSR program that enables an individual workstation to act as a master station. By loading NetOp's mouse driver, users can establish a "mouse to mouse" connection in Windows. To increase responsiveness of the mouse, the company suggests loading a special file on the remote PC after Windows has been loaded.

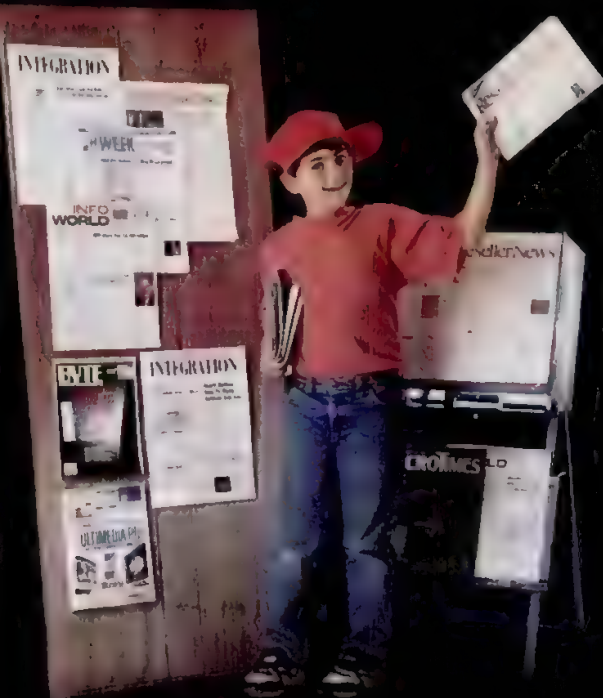
NetOp offers a "one to many" feature that allows monitoring of up to ten workstations simultaneously in resizable windows. Users can zoom in on one workstation at a time, taking control of the system. A screen broadcast feature for demonstrations displays the master station's screen on each networked PC. ■

**List Price:** NetOp, Version 3.0: for ten users, \$295; unlimited number of users, \$595.

**Requires:** For host, 400K RAM; for workstation, 6K RAM; DOS 2.0 or later, any network operating system running NetBIOS- or IPX-compatible protocols. Markham Computer Corp., 4720 NW Second Ave., Suite D-106, Boca Raton, FL 33431; 800-226-9696, 407-241-9600.

CIRCLE 424 ON READER SERVICE CARD





# EXTRA! EXTRA! READ ALL ABOUT IT!

## Micronics' 386 Mport 333 outperforms IBM, NEC & Toshiba 486 portables!

Are you ready for a Portable Desktop computer with 386DX-33MHz power that outperforms the 486 competition?

**Well then, you're ready for the Mport 333!**

Loaded with the power of Intel's 80386-33MHz micro-processor, 32K Cache Memory, 4MB RAM (expandable to 8MB), 3.5" Floppy, and internal hard drive options of 40MB to an unbelievable 245MB! The Micronics' Mport 333 has it all and yet weighs under 15 lbs.

### Hard Facts

Nothing adds credibility more than hard facts. We've known that the Mport 333 is an exceptional computer all along, but don't take our word for it.

*Computer Reseller News* recently reviewed 386/486 portable computers from Dolch, NEC, IBM, Micronics and Toshiba. In their series

of tests the \$4,795 Mport (the only 386 model) rated second only to the 486-50MHz "dream machine" costing \$16,995 and weighing 24 lbs.

The results stand. More words would be futile.

**Give us a call.**

Call 1-800-659-5901 for your free reprint of CRN's *Portables Pack A Punch* and to receive further information on our Mport portable computer and Mpack notebook computer lines.



| AGGREGATE                                                |     |
|----------------------------------------------------------|-----|
| Total seconds, lower is better                           |     |
| Dolch PAC 486-50E                                        | 38  |
| Micronics Mport 333                                      | 132 |
| NEC ProSpeed 486SX/C                                     | 133 |
| IBM PS/2 Model P75 486                                   | 189 |
| Toshiba T4400SX                                          | 204 |
| Results based on XXBench from XXCAL Testing Laboratories |     |

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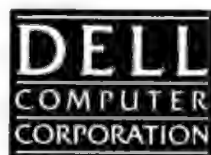
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## INTRODUCING

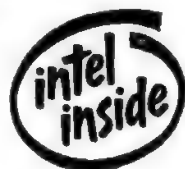


Dell 486D/16 16 MHz i486SX System  
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edited by  
Carol Levin

# Read Only

Reviews of the Latest Books for the PC User

## Cringely Makes Silicon Valley Shudder with Scathing Industry History

Even the most casual observer realizes that the PC industry doesn't play by old-fashioned, Fortune 500 rules of business. In no other industry do ideas become products and sparks of genius transform into multimillion dollar empires so quickly.

It's the genesis of these *Accidental Empires* that Robert X. Cringely chronicles. *InfoWorld*'s pseudonymous gossip columnist presents a fast-paced, often hilarious trip through the computer industry from 1975 to today. Cringely's account is essential reading for anyone who wants a funny, honest, and scathingly cynical history of how Apple, IBM, Lotus, Microsoft, and others did it, and predictions on how they might undo it yet.

Cringely's take on the industry is plainly stated in the opening pages. "It all happened more or less by accident. The people who made it happen were amateurs. And for the most part they still are." From that point on, it's 300 pages of identifying and deriding these amateurs, most of whom are now multimillionaires.

Cringely's thesis may scare you. Is this multibillion-dollar industry really built on a foundation of idiot savant nerds who are madly driven to succeed in order to overcompensate for the pain and torment of adolescent exclusion?

Microsoft chairman Bill Gates, the quintessential nerd and the industry's biggest success story, gets Cringely's worst abuse. Gates is compared with Saddam Hussein, Oedipus, and China's "Last Emperor." In fact, the chapter on Microsoft, titled "Chairman Bill Leads the Happy Workers



In Song," is so scathing that Cringely may be arrested the next time he arrives at the Seattle airport. But beyond the name-calling and wisecracks about Gates' personal hygiene is a thoughtful analysis of how and why

Microsoft has succeeded and what it will have to do to stay on top in the coming decade.

Apple's Steve Jobs ("Little Joe Cartwright" in Cringely's

extended "Bonanza" metaphor), John Sculley ("not an easy man to be with"), and Jean-Louis Gassée, ("the phony-baloney Frenchman,") don't fare much better, but again, Cringely follows up his colorful anecdotes with interesting predictions about the future course Apple will have to take to survive.

Other success stories (and failures) recounted by Cringely include IBM, Lotus, Compaq, Digital Research, Novell, and Adobe. In most cases, a pattern seems to emerge. A nerd/genius has a great idea, implements it, and makes a fortune. He is then

forced to go public, ends up bumbling management, and is left sitting on top of a pile of money wondering what to do next. One conclusion is obvious at the end of this fun, informative, and ego-deflating slash-and-burn history lesson: Cringely, you'll never eat lunch in Silicon Valley again.—Don Willmott

### **Accidental Empires**

by Robert X. Cringely, \$19.95, Addison-Wesley Publishing Co., Jacob Way, Reading, MA 01867; 800-447-2226, 617-944-3700. ISBN: 0-201-57032-7.

CIRCLE 462 ON READER SERVICE CARD

## Running LANtastic Offers Networking Strategies for Popular Low-Cost LAN

Building your first network does not have to be an odyssey into the obscure and arcane, especially if you use *LANtastic*, Artisoft's popular DOS-based peer-to-peer network. *LANtastic* has loyal users and has gained

widespread popularity due to its low price, reliability, and ease of use. But, as author Adrian J. King states in *Running LANtastic*, its simplicity often belies its capabilities. King's comprehensive guide to *LANtastic* takes knowledgeable PC users—those making their first foray into networks and those looking to optimize LAN performance—to a new level of proficiency.

Configurable as a simple 2-user system all the way to a 100-user corporate solution, *LANtastic* can be enhanced with a Windows front end and equipped with a voice adapter that lets you chat over data wires. And its programming interface opens up a range of possibilities for C programmers.

King covers all this, but begins



with a primer on network architecture, its terms, topologies, software, and hardware components—including cards, cables, connectors, and terminators. He follows this up with an overview of the entire Artisoft product line,

which gives away the author's ties to Artisoft: He is currently vice president of engineering. King previously worked at Microsoft on early versions of DOS and Windows and was also part of its networking group.

*Running LANtastic* quickly moves from this general overview on to specifics about installing and configuring *LANtastic*, followed by a discussion of network utilities—NET, NET\_MGR, and LANPUP. Once your network is installed, the three chapters on using and managing the network, network printing, and the NET command line interface will keep you up and running. Advanced topics include memory usage, multiple network adapters, remote booting, special network configura-

tions, and improving network performance.

*Running LANtastic* includes coverage of *LANtastic Z*, which allows you to hook up a system (usually a portable) to the network via a direct connection or modem, without having to install a network card. Less useful but interesting nonetheless is the primer on the Artisoft Sounding Board, which digitizes sound and allows you to record or play back voice files. King wraps up his guide with a chapter on the *LANtastic* Programming Interface and even includes details on downloading source code for the sample programs. He also ends each chapter with a summary that greatly aids in the book's skimmability.

Like the program itself, *Running LANtastic* efficiently and elegantly packs a wealth of material in an economical package that serves a wide range of network users.—Wendy Dugas Pérez

### **Running LANtastic**

by Adrian J. King, \$27.95, Bantam Computer Books, 666 Fifth Ave., New York, NY 10103; 800-223-6834, 212-492-9479. ISBN: 0-553-35440-X.

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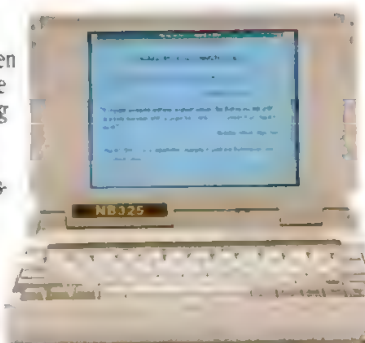
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### Strunk and White Revisited: Style Guides for Desktop Publishers

Samuel Johnson once offered this criticism of a manuscript submitted to him:

"Your manuscript is both good and original; but the part that is good is not original, and the part that is original is not good."

If you have ever tried your hand at desktop publishing (DTP), you know what Dr. Johnson means.

Just as writers consult Strunk and White's *The Elements of Style*, desktop publishers need such a reference when preparing documents electronically. James Felici's *The Desktop Style Guide* and Robin Williams's *The PC Is Not a Typewriter* are two such quick reference guides, complete with

concise rules for creating professional manuscripts electronically, clearly illustrated examples, and definitions of both typesetting standards and their electronic counterparts.

*The Desktop Style Guide* is thorough and succinct, clearly modeled after Strunk and White's crisp, no-nonsense style. Felici addresses a wide breadth of typographical tradition by subject, ranging from "Typographic Basics" to "Preparing an Electronic Manuscript." Novices will appreciate the clear definitions of publishing terms such as leading, rags, widows, and orphans and explanations of how honing (or avoiding) them is important to the appearance of your documents.

Clearly marked figures illustrate various key conventions,

such as normal versus tight character spacing, and compare typographical formats, such as the effective use of drop-cap letters. Old-school typesetters who want to modernize their skills are instructed on formatting an ASCII manuscript and tagging an electronic document.

*The PC Is Not a Typewriter* is more elementary in scope than *The Desktop Style Guide*, but it is equally clear. Designed to wean die-hard typists from their monospaced mentality, Williams's guide compares typewriter-style typesetting with DTP and concentrates on the various DTP tools.

Like *The Desktop Style Guide*, *The PC Is Not a Typewriter* defines basic typographical elements and special characters, such as the em dash and accent marks. Unlike Felici, however, Williams shows exactly how to access these characters in popular software including *Microsoft Word*, *PageMaker*, *Ventura Publisher*,

and *WordPerfect*, offering specific tips so that first-time buyers can make informed purchases.

Both authors have written excellent typesetting style references. *The Desktop Style Guide* is a true reference book that will complement the library of anyone serious about professional publishing. *The PC Is Not a Typewriter* is a short, unpretentious how-to guide, a fine choice for desktop publishers in the making. Either book will help you create documents that look good; the originality is up to you.—Susan G. Thomas ■

#### **The Desktop Style Guide**

by James Felici, \$11.95, Bantam Books, 666 Fifth Ave., New York, NY 10103; 800-223-6834, 212-492-9479. ISBN: 0-553-35445-0.

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#### **The PC Is Not a Typewriter**

by Robin Williams, \$9.95, Peachpit Press, 2414 Sixth St., Berkeley, CA 94710; 800-283-9444, 510-548-4393. ISBN: 0-938151-49-5.

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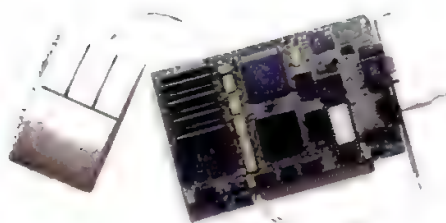
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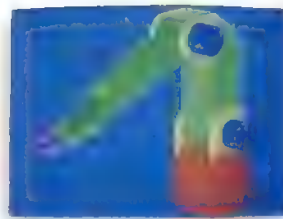
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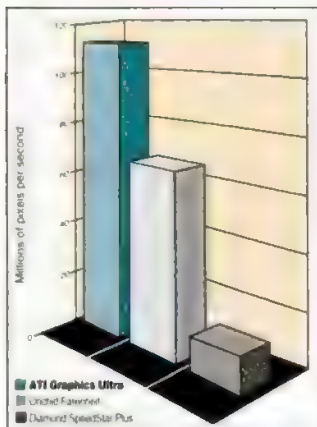
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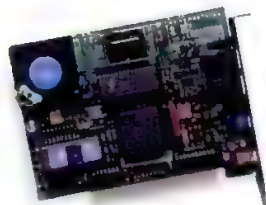


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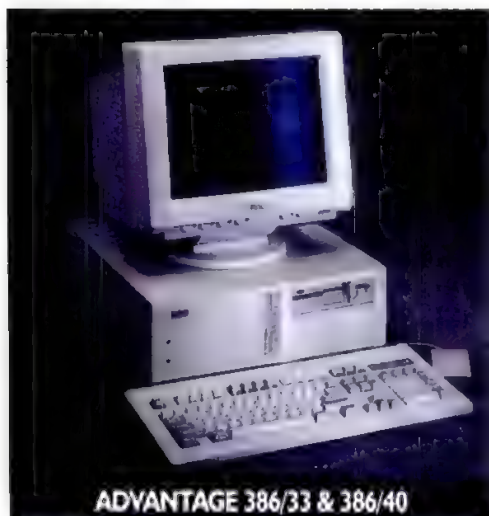
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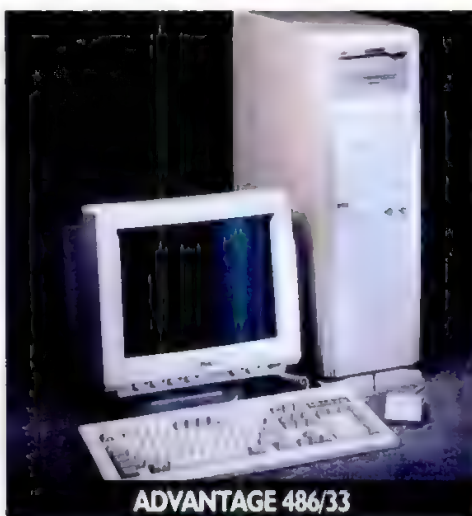
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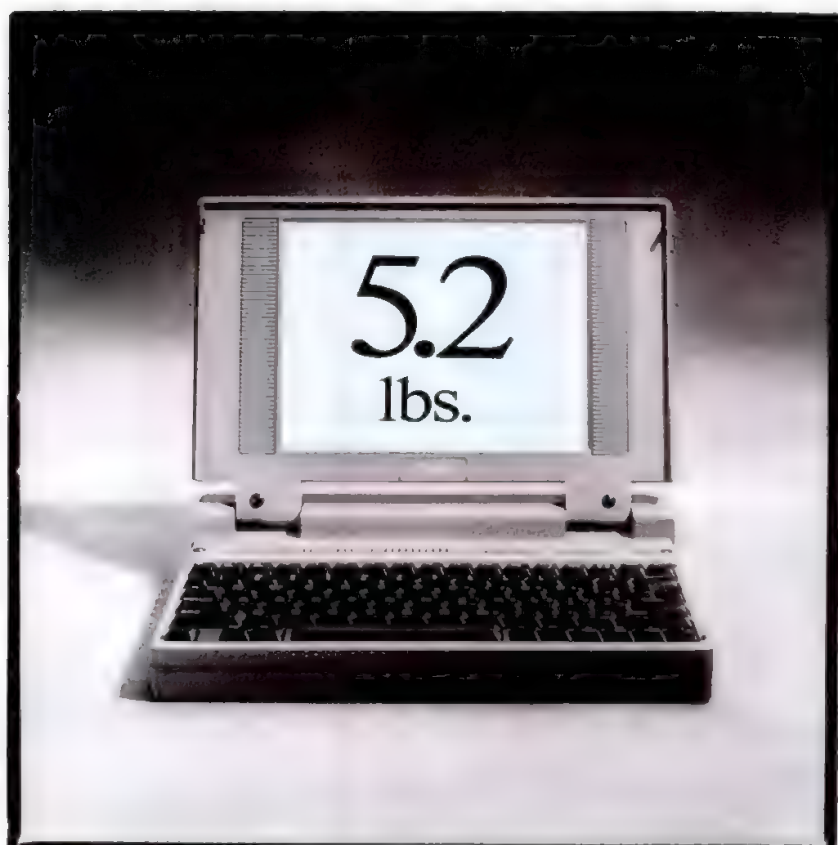
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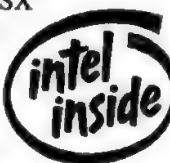
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edited by  
Trudy Neuhaus

# Toolkits

Reviews of the Latest Tools for the PC Programmer

## Doc-To-Help: An Elegant Way to Create Windows Help

Windows is a user-friendly environment. A good case in point for this is Windows' Help Engine. It not only provides users with a standardized help interface, but one that is feature rich—beyond mere context-sensitive help. *Hypertext links* (also known as *jump words*) allow you to jump from one part of Help to a related part. When a term in Help is underlined with a dotted line, you can get a pop-up definition simply by clicking on that term. You can also search on a keyword linked to help topics and be presented with a list of related topics.

However, *creating* a help file is far more difficult than using one. First, you will have to purchase the Help Compiler. If you are a Windows programmer, you probably already have the Help Compiler (since it's shipped with the Microsoft Windows SDK and a number of third-party language packages). However, nonprogrammers will have to purchase it separately.

Second, you'll want to purchase *Microsoft Word for Windows* (*WinWord*). The Help Compiler will only accept source code in a special file format called RTF (rich text format). Although several word processors can export RTF files, unless RTF is their native format, dealing with RTF files is often awkward. *WinWord* is the only popular word processor that has RTF as a native format, so it's your best bet.

Third, when you have everything you need and are ready to write the RTF help file, you'll find that footnotes with arbitrary conventions are used to indicate jump words, pop-ups, and other



features. While these are not impossible to remember or implement, they certainly don't make it any easier. In fact, nonprogrammers who might put the Help Compiler to good use by creating manuals and guides are often put off by a syntax that looks as if it's for programmers only.

Enter WexTech Systems' \$249 Doc-To-Help—an elegant way to go from *Word for Windows* 2.0 files to help files. It provides a set of *WinWord* templates that automate the production of Windows help files. The Help Compiler and the Windows 3.1 Help Engine are bundled with Doc-To-Help, and you are licensed to redistribute the latter.

A *WinWord* template can include *styles*—items that attach to the standard *WinWord* menus—and, most importantly, *macros*—miniprograms written in WordBasic. You prepare a

source file by creating a *WinWord* document based on one of the supplied templates. The arbitrary conventions that the Help Compiler normally uses are replaced by ones based on the familiar structure of *WinWord* documents. For example, hyperlinks are made via *WinWord* bookmarks and cross-reference fields, and index entries become search keywords. And if you forget the rules, there are menu items like "Insert cross reference."

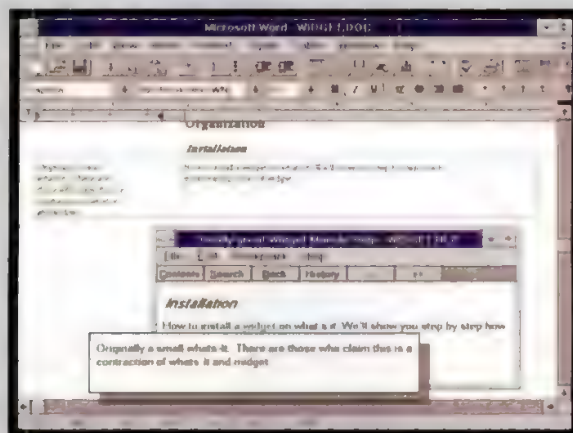
Once you've completed the source file, choose "Make Into Help" (which is one of the menu items added to the format menu) and then sit back. If you ever questioned whether macro programming is *real* programming, the macro run by this menu choice should convince you. Right before your eyes, you'll see *WinWord* open a new document with a special help template and copy the text document to the new one. Then the macro goes through translating the Doc-To-Help syntax into the obscure ones used by the Help Compiler. Finally, the macro saves the file in RTF.

makes the required project file (which controls how the Help Compiler builds your topic files), and shells to DOS to run the Help Compiler itself.

If you want to create context-sensitive help, you need to know the relationship between a help file's topic and the context. This relationship is known as a *map*, and it is assigned a number. With such a map, your program can call Help Engine, supply a number, and call up the right topic. After you've compiled your help, one of Doc-To-Help's added menu items will place the map into a new document providing the data a programmer needs to set the right hooks.

Doc-To-Help also includes templates that assist you in formatting documentation. Noteworthy is a rather elaborate set of indexing macros that allows you to search for given keywords that you've assigned to multiple index topics. But it would have been nice if WexTech Systems had incorporated a way to import previously created RTF help files so that you could refine them with the Doc-To-Help tools. Maybe we'll see such a feature in a future version.

If you need to produce Windows help or hypertext on-line files on a regular basis, you owe it to yourself to get this package rather than suffer the frustrations associated with the native Help Compiler.—Barry Simon



Doc-To-Help pop-up definitions appear in the source code as text, with the definition in the left-hand part of a two-column table; here's a source file and the compiled help showing the pop-up.

### Doc-To-Help

WexTech Systems, 60 E. 42nd St., New York, NY 10165; 212-949-9595.

**List Price:** \$249. **Requires:**

*Microsoft Word for Windows* 2.0.

**In Short:** A set of well-constructed *WinWord* templates to produce manuals and Windows Help. With the Help Compiler included and a humane syntax, anyone producing Windows Help will love this package.

CIRCLE 451 ON READER SERVICE CARD



Unlike most printers that merely claim to be appropriate for network applications, the QMS-PS 1700 was conceived and built to fulfill one basic objective: To be the most efficient printer there is in a network environment. In terms of cost, as well as performance.

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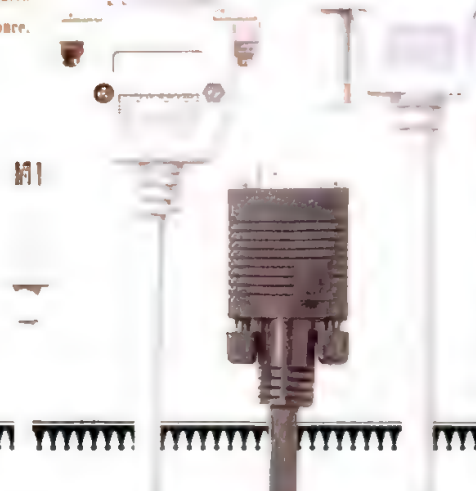
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The Emulation Sensing Processor or ESP selects the appropriate printer language without time consuming reconfigurations.

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What's more, if a job is interrupted for any reason, this printer has the intelligence to reprint any needed pages and then continue with the job.

Its context switching capability preserves "states", such as fonts and macros, when switching between emulations so you needn't waste time downloading them each time an emulation is selected.

Storage capacity for font caching, and font or emulation storage, can be expanded with optional internal and external SCSI hard drives.

And there's even an optional System Security Card that lets the LAN administrator control settings and avoid the chaos that can result from unauthorized end-user adjustments.

The QMS-PS 1700 is quite a bit more than a laser printer. In fact, it's exactly what most work groups need but haven't been able to find. Until now. The QMS-PS 1700 is The Network Printer.

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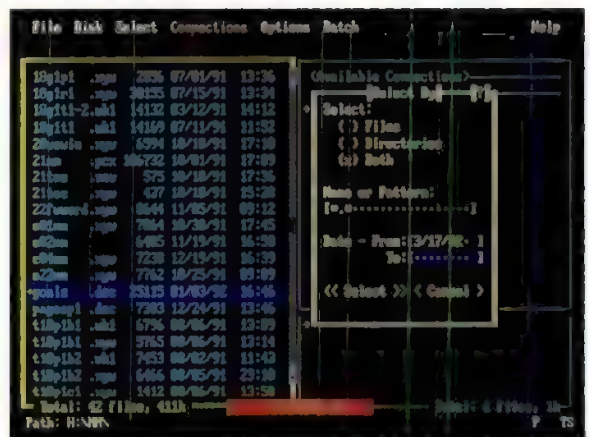
## A black and white portrait of a young man with dark hair and glasses, wearing a white shirt and a dark tie. He is looking directly at the camera with a neutral expression. The photo is mounted on a light-colored card with a decorative border.

If you have a notebook computer that has a built-in hard

I often run Microsoft Windows on my notebook machine. If I have a Windows applica-

Generally, I do only the simplest kind of backup. Almost every evening I do an incremental backup of all the files that I created or

**A 4-pound notebook may be cutting-edge technology, but if you can't install your software on it, it's useless.**



updated that day. This includes important e-mail messages sent and received, documents written, and occasional spreadsheets revised. Program files can always be reloaded, but once you've lost your data, it's gone for good. So I



## Michael J. Miller

try to back up my new or changed files every night onto a floppy disk. It may sound excessive, but it's really pretty easy to do.

You don't need a floppy disk for backup, but it sure helps. The suggestion that you should back up files by sending

electronic mail to a central file server or to your desktop PC is crazy. It takes too long and it's too much of a pain. The result is that you simply won't back up as much as you should. Carrying an external floppy drive doesn't improve things, either. It's just another bulky piece of hardware to tote around with you. I've used notebooks that have these external floppy drives. Most of the time, I simply left the drive at home when I traveled.

In the long run, I'd be willing to trade in a floppy drive for a replacement, such as a RAM card. But right now, these cards aren't even close to matching the cost-per-capacity of floppy disks.

### HAVE FLOPPY, WILL TRAVEL

At the moment, my favorite notebook computer is the 5.5-pound Toshiba 2200SX. It is a 20-MHz 386SX, which seems fast enough, although of course you can never have too much speed. I use *Stacker 2.0* to double the hard disk capacity to about 120MB. I use *LapLink Pro* to transfer data from other machines and often just as a local file manager for things such as simple backups. I usually get more than 3 hours on a charge, and the battery charger is among the smallest I've seen. My only complaint is that the machine wasn't designed with a place for an internal RJ-11 jack for plugging in a phone line. So I have an internal modem, which works well enough, but the connector to the phone sticks out like a little tail.

Would I like it to weigh less? Sure. But not at the expense of the floppy drive. Removing it only seems to remove half a pound or so. Other things being equal, I'd choose a 5-pound machine with a floppy drive over a 4-pound machine without one any day.

Of course, I'd also like to see more very lightweight machines for specialized purposes. Hewlett-Packard's 95LX is a great example. This palmtop does a wonderful job of running spreadsheets. I'd love to see a similar machine for e-mail. Designers can probably come up with many other single-purpose machines that would be lightweight and wouldn't need a floppy drive. That's fine with me.

A lighter machine, however, is not at the top of my priority list. I'd rather see color screens, larger hard disks, and better battery life. Give me those features (plus an internal modem and phone connector) in a 5-pound machine, and I'd probably end up using my desktop computer a lot less. I expect, though, that within the next year or so, we'll have 5-pound notebooks with a reasonable color screen, a 120MB hard disk, a 2- to 3-hour battery life, a slot for add-in cards, and a floppy drive. I can hardly wait.

Still, I need a notebook that can run lots of general-purpose software. I use lots of programs, I'm always trying something new, and I believe in frequent backups. As a result, I'll take the larger notebook—the one with the floppy drive. ■

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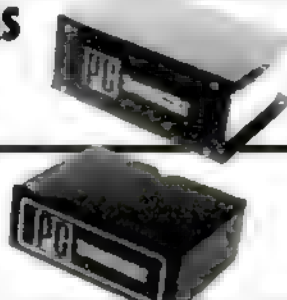
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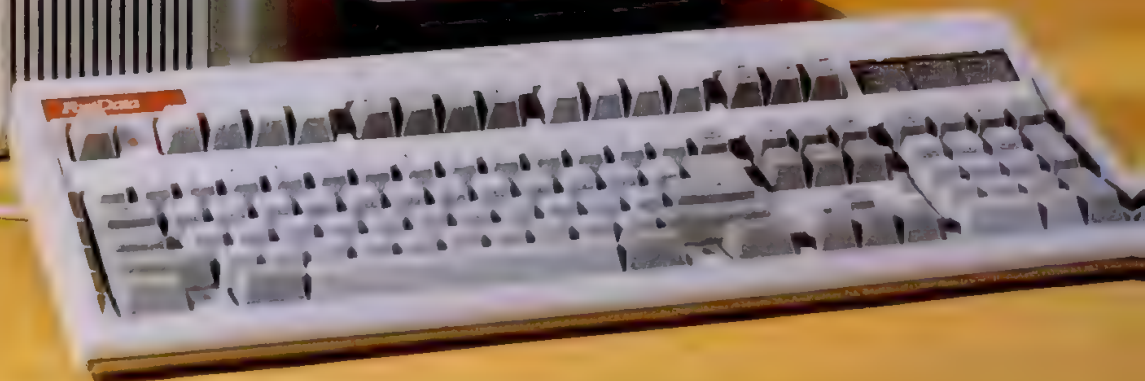
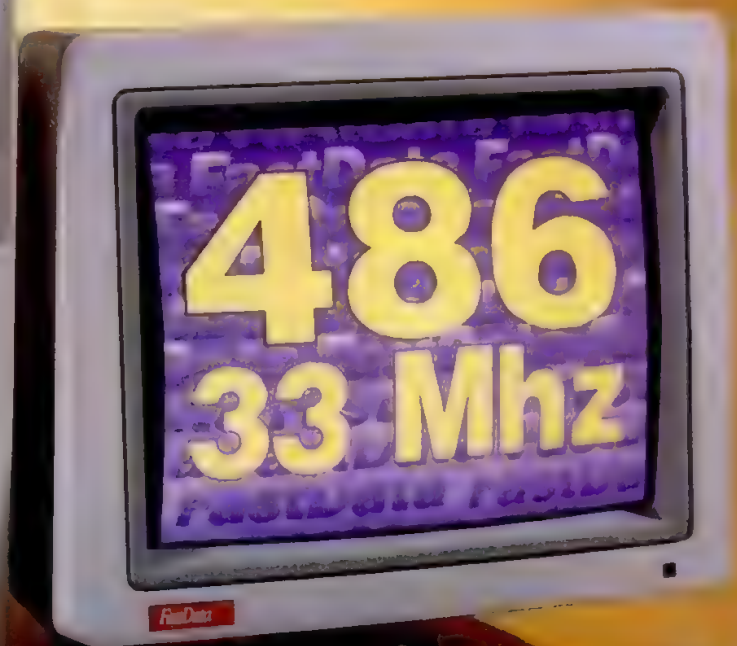


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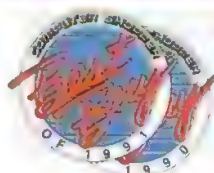
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**SPC** SOFTWARE PUBLISHING



# Bill Machrone



## Time for A New Interface

**Just as the Windows interface is really taking hold, it's coming up short. And object orientation is the reason.**

Long live the right mouse button! For in it lies our salvation from Windows' tyranny of endless pull-down menus and forgettable speed keys. Here's the problem: As Windows programs grow ever richer in features, the menus get deeper and more complex. Many choices bring up a dialog box with even more choices, or another set of menus, which in turn may bring up dialog boxes. Windows' lack of sticky menus forces us to go through numerous mouse clicks and drags to set or change options. The solution is that other mouse button.

In his column, "The Riddle of the Right Mouse Button" (January 14, 1992), Michael Miller documented the widely differing uses of the right mouse button by various applications. His survey showed that software manufacturers care nothing for consistency, and use the right button as they see fit to enhance their applications. As Windows applications proliferate, this open-ended pattern cannot continue.

There's a deeper problem, too: the Windows interface itself. It's based on IBM's Common User Access (CUA) specification, which is part of Systems Application Architecture (SAA)—IBM's answer to the longstanding criticism that each of its hardware platforms has different interface standards for hardware, software, and communications. SAA is a huge, sweeping specification that ostensibly will bring the disparate mainframe, minicomputer, and PC platforms together. CUA is a relatively small part of that super set; it addresses only the screen and keyboard. In turn, the pull-down screen interface is a small part of CUA. The basic work was done nearly ten years ago, and its age is beginning to show.

### THE OBJECT ANGLE

The whole idea of a pull-down interface is that you can logically organize all the functions of a program in several major categories, then access the functions hierarchically. It makes sense, and it works—to a point. It breaks down when you must go back to the same menu again and again.

*Word for Windows 2.0* is a perfect example of this menu frustration. Sometimes you'll

want to run it with the ruler, ribbon, and icon bar; other times, you'll just want a clean screen. It's six trips to the menu to change from one mode to the other. Another example is when you want to fit type by eye, say with Windows Write. You can select the text and repeatedly press Alt-C-E, which calls up the Character menu and the Enlarge option. Within the context of the existing interface, it would be far easier to lock the Character menu or Fonts submenu in place so that you could just click on the desired action and observe the results.

*GeoWorks* is an example of another method of menuing. It has tear-off menus, where you pull down the desired menu or submenu and lock it in place. Then you're free to move it anywhere on the screen. Tear-off menus are handy but they also tend to clutter the screen.

Object orientation brings a fresh point of view to what we've been doing all along. And the right mouse button is the ideal way to invoke it. By selecting an object on the screen and clicking the right mouse button, you should get a menu of *all the things you can do right now*. In the aforementioned example of selecting some text, you should be able to alter any of its characteristics: font, size, attributes such

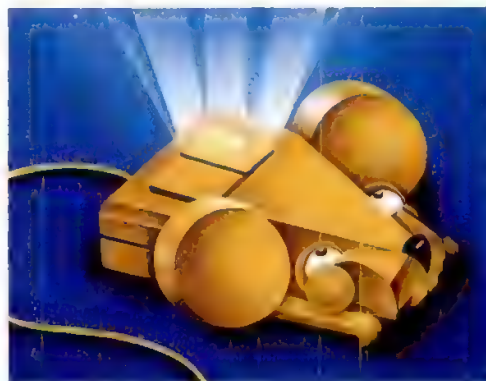


ILLUSTRATION: NED SHAW

as underlining or bolding, color, opacity, and so on. You should have the further option of making the properties menu sticky, and having your selections take effect immediately. After all, what's the point of a visual interface if you have to wait, even for the closing of a window, to get results?

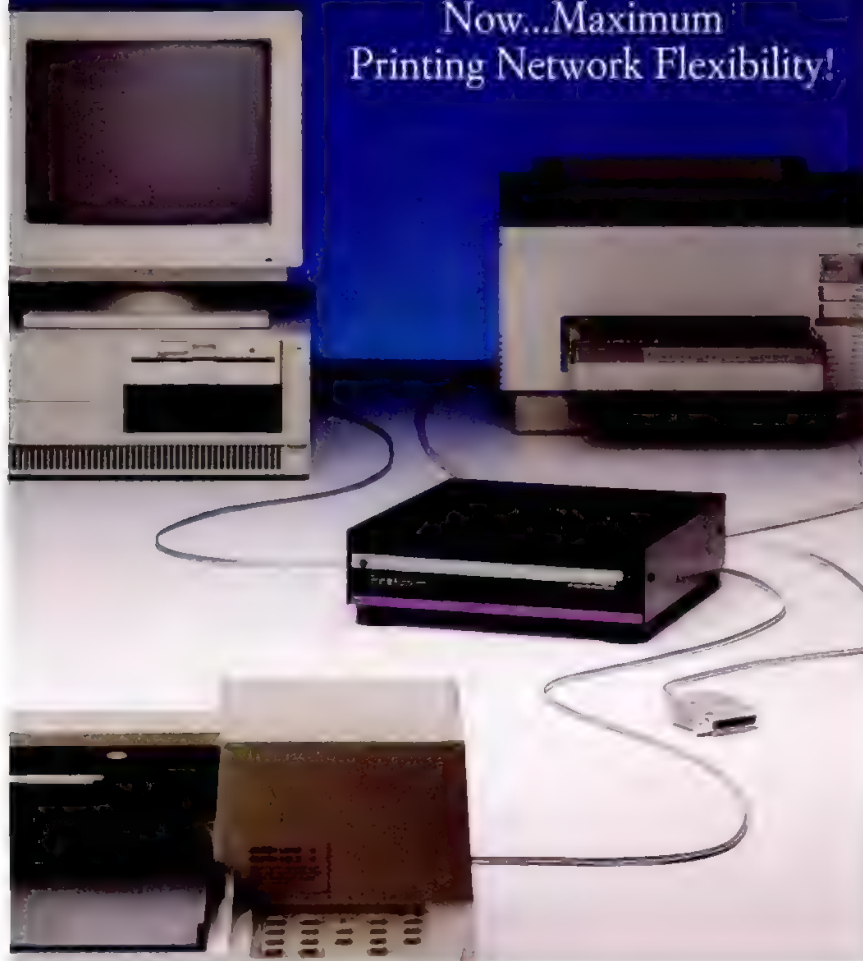
### DRAW & DROPPINGS

The Windows interface is similarly useless in handling another feature that's gaining popu-



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## Bill Machrone

larity by leaps and bounds: drag and drop. Shells such as *The Norton Desktop* for Windows and *WinTools* implement drag and drop across applications. Drag and drop overcomes the ugliness of cutting something out of the document and into the Clipboard just so you can paste it somewhere else, either in the same document or even in another application. With drag and drop, you highlight the desired information, then hold down a button to drag it to its new home. My fond desire would be to drag the data with the left mouse button and drag its properties with the right button. Being able to drag the properties would be incredibly handy for doing repetitive formatting. It would also be a handy way to implement inheritance, another cornerstone of object orientation.

Inheritance allows an object to inherit its properties from another object. Picture an application that allows you to pop up a "styles in use" box that shows all of the styles in your document. In effect, you're creating a stylesheet or template as you go. You'd be free to save the stylesheet or properties list to a file, or to drag properties from the list to another document.

This raises the question of whether objects that inherit properties from one another should have those properties linked, so that if you change the first, the second will change, too. More important, should the links be bidirectional? That is, if you change the properties of the second object, are the properties of the first changed? We can all think of examples in which it would be useful to have the properties unlinked, directionally linked, and globally linked.

My examples are word processor oriented, but the same principles apply in spreadsheets, presentation graphics programs, or even telecommunication programs. Slowly, we're beginning to see these tools trickle into today's applications—a sure sign that they'll gain popularity in the coming years.

### WINDOWS TO THE RESCUE

Rather than letting each software vendor implement its own version of these tools, it's critically important that Microsoft take the initiative and expand the user interface to manage objects. Without leadership, Windows applications will follow DOS applications into chaos. ■



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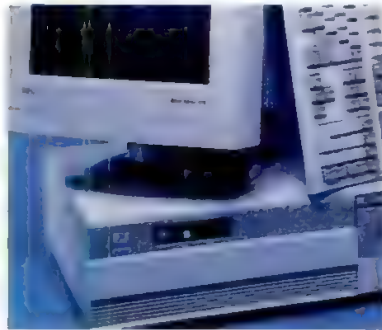
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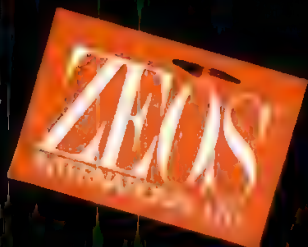
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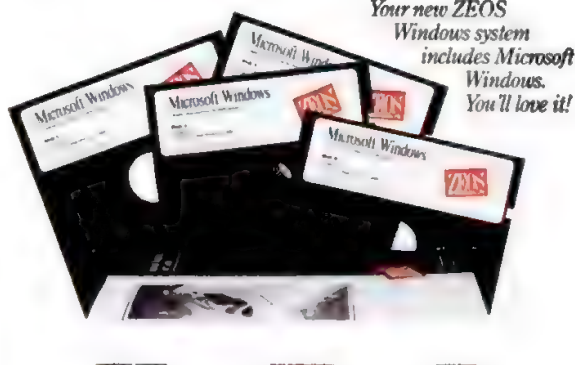
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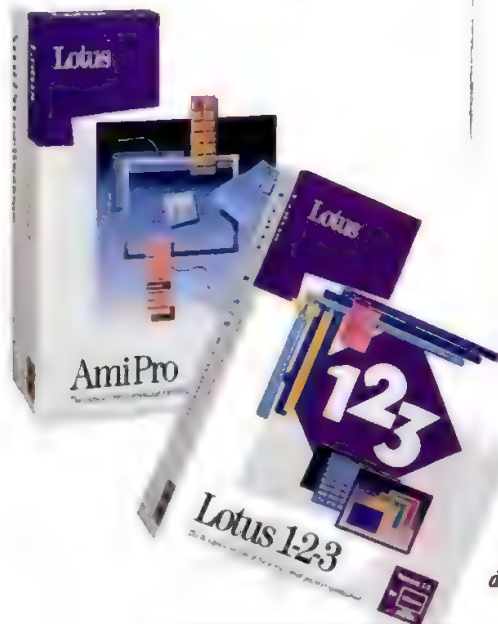
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# John C. Dvorak



## A Future Of Sloth

**Have modern technological advances surpassed the capabilities of the human spirit?**

It was the voice of a typical PR guy on the other end of the phone line.

"Can I get your fax number again? We can't get through."

"I'm out of paper. What are you going to send?"

"An invitation to a press brunch."

"Mail it!"

The fax machine is getting on my nerves. I find it useful when you have to get things to people in a hurry. I do a lot of public speaking and get constant requests for my bio to be faxed immediately, "because we're working on the brochure." Communications methods such as faxing and Federal Express should be used judiciously and not abused, as they currently are. I get half a dozen FedEx overnight letters containing press releases each day. While this is hardly a deluge, it is an ominous trend.

I get hundreds of useless press releases a week in the mail, and they get thrown out because PR companies insist on broadcasting useless information to everyone. (Don't these companies realize that they're hurting both their own customers and everyone else's, too?) I can't tell you how many times I receive a press release about how some comptroller has been promoted to associate VP of finance for such and such a company. Who cares? Why am I getting the announcement? I write about trends and products—not personnel changes! To get such an announcement by Federal Express or fax is particularly galling since these channels should be kept clear for emergency communication or "absolutely positively" overnight stuff.

Federal Express helps keep this nonsense to a minimum, since it costs over 5 bucks to send an overnight letter. Faxes cost little more than the mail and arrive instantly, making the temptation to use them all the time overwhelming. The PR guy in the exchange above (a real conversation) was genuinely stunned that I'd suggested mailing something.

The main problem with the indiscriminate use of faxes is that the sender loses control of the presentation. A message is more than words. If it's not, use e-mail—the perfect medium for

mere words. The message is just one part of a presentation; there's the paper, the typeface, the envelope. A good presentation gets more attention than a lackluster or tasteless one. When you fax a document, this is all lost. The result is a degraded image on a sheet of horrid, smelly fax paper.

Why would a company subject itself to such a fate? Well, the fax is part of a growing laziness problem. Technology is supposed to improve the quality of business. Instead, it has introduced a screwball kind of laziness that may explain the unfulfilled promise of increased productivity where computers and other new technologies are employed.

You have to wonder about all new technology when you see what a fax machine does to a person. Laziness and high technology seem to be partners in the future. Just go to any supermarket and watch the cashiers. They scan stuff in and pay no attention. When the bill is rung up, they always look at the register to see what the change should be. If an extra zero goes in, so what? I saw a guy hand over a \$1 bill and watched the clerk punch in \$100 by mistake! The clerk, robotlike, started to give the guy \$99.50 in change, knowing full well that he received only a dollar.



ILLUSTRATION: NED SHAW

Meanwhile, most children have become addicted to calculators. When voice recognition hits the market, we can assume that our society's waning ability to write will diminish along with the math skills killed off by the calculator. Until then, we can watch office employees degenerate into fax-machine drones. I may as well get used to buying rolls of smelly paper.





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And that's how Jim Powell likes it. Because as Texas Instruments' Manager of Distributed Information Services, it's his job to provide his co-workers with the computer support they need. And with Microsoft client-server computing, his job is a lot easier.

Two years ago, a lot of people at Texas Instruments found the mainframes difficult to use and inflexible.

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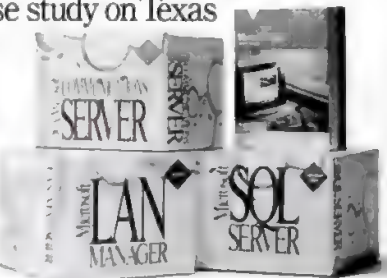
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needed. And with Windows, the information on the mainframes was easier to access.

Simply put, Jim was able to get the right information, to the right people, the right way.

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# Inside Track

While **naysayers** were predicting that a deluge of Windows applications and cheap 386 clones would spell doom for

Apple Computer, quite the opposite has happened. Due to the success of the low-end Macintoshes, **Apple's market share has increased**, and even cheaper Macs in the future seem certain to be even more successful.

**The key** to all this is the single-source-vendor philosophy. While people criticize the notion, it's far superior to open architecture, particularly when things get too complicated. Apple's control over its hardware and operating system architecture demonstrates that a stable graphical environment must be better integrated with its hardware platform than Windows is with the Taiwanese clone and the **BIOS of the week**. There are too many BIOS chips and too many odd designs in the world of PCs for a complex operating system such as Windows to work without people **complaining about weird bugs**.

OS/2 was going to solve this dilemma by making certain that each machine was designed around its own dedicated version of OS/2. You'd get OS/2 from the vendor of the computer. It would be highly integrated with the individual machine. But users saw this as **an invasion** of the open-architecture notion and moaned about not having a "generic" OS/2 that would boot on every machine. So OS/2 was made more **generic**.

Meanwhile, the users are confronted with two distinct platforms that dominate the desktop scene. It's become a policy in most corporations to require the employees to have one or the other. The choice is usually made by the company. A Mac user with a PC on his desk at work finds this unreasonable and vice versa. Few employees can have or can **afford to have two machines** (even if they have enough space). The best solution for this is a \$995 PC card (from Hydra Systems, 1340 S. Saratoga-Sunnyvale Rd., #106, San Jose, CA 95129; 408-253-5800). The product is called the Andor One. **It's an Apple Macintosh Plus on a card!** It includes a SCSI port, an Appletalk port, and other necessities. A hi-tech Hydra honcho told me that while many corporations will not allow a user in a PC environment to have a Macintosh, they will allow them to buy this card "because it's regarded as a PC peripheral"! Will they ever learn?

Anyway, **the drawback** to the card is that it requires the buyer to scrounge some old Apple 128K ROMs and a copy of the Mac system software. Of course, **Apple should wise up** and simply buy this company and sell this product itself.

Digital Equipment Corp. has decided to get on the direct-sales bandwagon, and those inside DEC are saying that Dell Computer Corp. will be their model.

**Last Guy on the Bus Dept.:** While the Apple-PC battle continues, **Digital Equipment Corp.** has decided that it will get on the direct-sales bandwagon. The company's belated entry shows you how long it takes for today's massive corporations to make a move. DEC, as you've probably seen by the ads, intends to sell **cheap clones** just like the Zeos and Northgate guys do.

I was told that the corporate big shots inside DEC are saying that **their model will be Dell Computers**, which they see as epitomizing the way direct sales should be done. What Dell has done masterfully is rise above the lowballers and create a high-volume company with low prices, but not the lowest prices. Hence profits! You can be sure that a company used to big-time profit margins such as DEC **hates the idea of mucking** in the "nobody beats our prices" mire. So they see Dell as the model. The difference, though, is that Dell **paid its dues** and was, for a long time, a complete lowballer. It changed its style only after establishing its brand name. DEC is not following this formula.

**Get This Book Dept.:** Professor David A. Aaker at the University of California told me that what Dell did and the way it did it **epitomized perfection** in brand-name management. His recent book, *Managing Brand Equity* (from The Free Press, 866 Third Ave., New York, NY 10022; 800-323-7445, 212-702-4771), is a must-read for any marketing maven or would-be marketeer who wants to know how brand names work in today's market. It's the best \$24.95 you can spend. We can only hope that the fellows at DEC will get a copy, too. Even if you're not in marketing, **this book is fascinating**.

**CD-ROM of the Month Dept.:** There are more and more vendors of CD-ROMs, each with a better idea. I think a **terrific** CD-ROM comes from Bureau Development (141 New Rd., Parsippany, NJ 07054; 800-828-4766, 201-808-2700) with its *Monarch Notes on CD-ROM*. All the *Monarch Notes* (including many that have long been out of print) have been incorporated into one \$99 CD-ROM.

If you're not familiar with *Monarch Notes*, these are guides to the great literature of the world. They're used primarily by students who don't want to read the great works but are required to know them or write an essay about them. Bureau Development's disk should be a **dream come true** to today's students in college or high school, **especially with its cut-and-paste features!** ■





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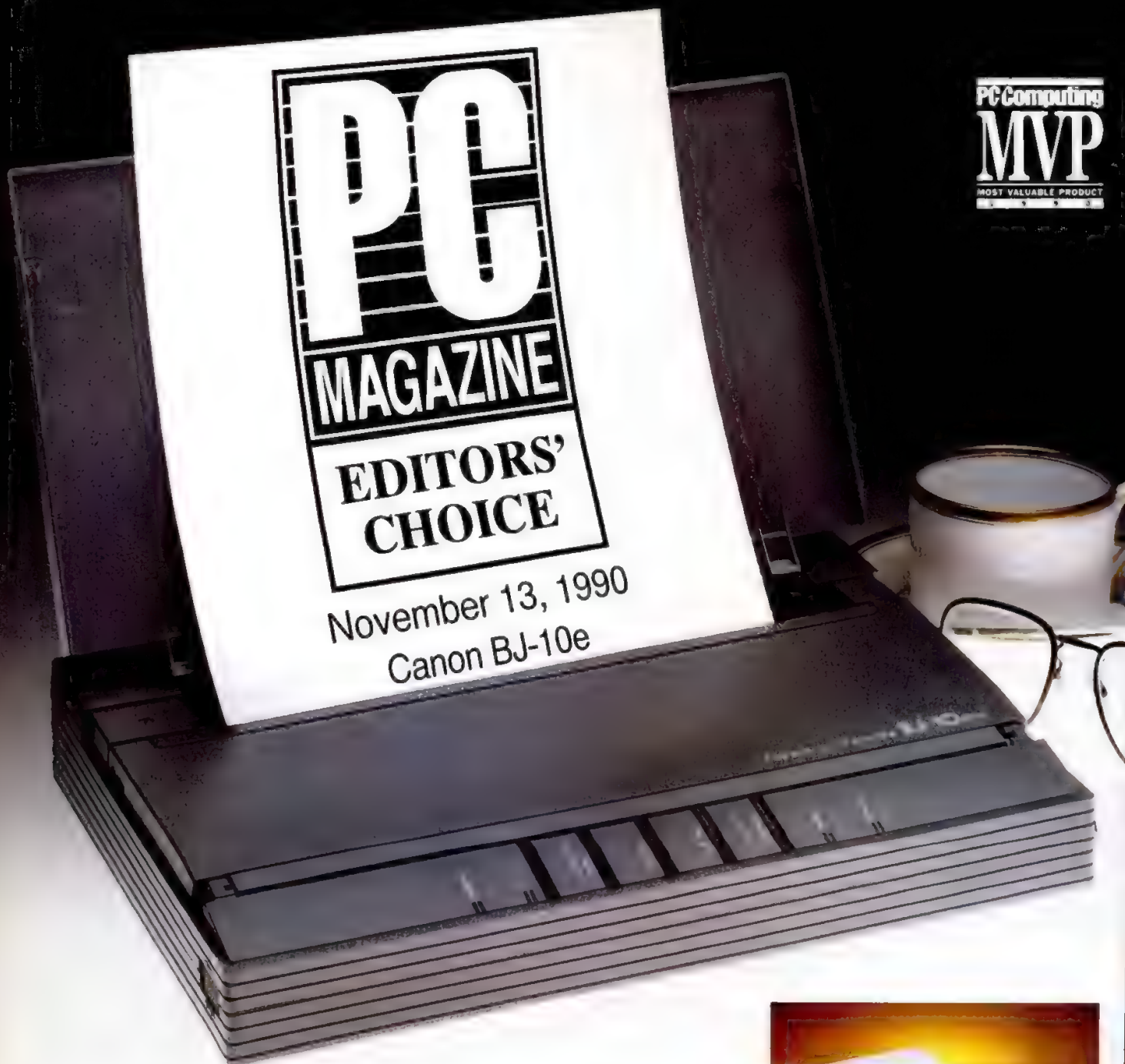
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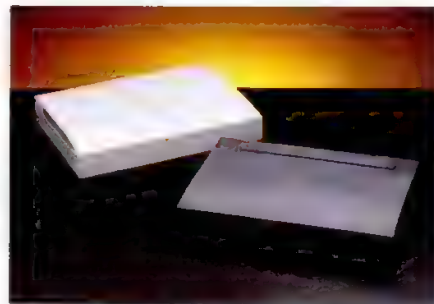
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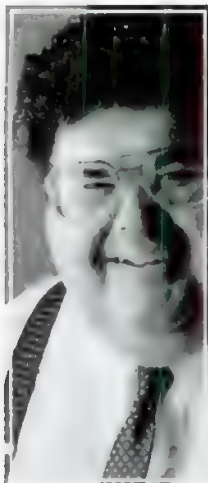
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# Jim Seymour



## Making Good GUI Sense

**Windows 3.0 has spurred on the software industry, and it's driving video hardware sales, too.**

I said here a year ago that I thought the success of Windows was going to redefine how we thought about PC display systems. It turns out I was right, but I didn't go far enough.

Making good use of a graphical user interface demands a lot of screen real estate—so you can see what's happening in a window, and so you can have more than one usefully large window open at once.

The old 13- to 14-inch standard for PC displays just isn't big enough for GUI environments. That's aggravated, of course, by displays that hide a lot of the tube behind the bezel, or—worse still, and very common—

don't fill the part that is visible from corner to corner. (There's no mystery here: The engineers couldn't get a sharp image from corner to corner, so they just masked-off the outside half-inch or more of the tube. What a *big* difference that makes in the image size!)

This year's new 15- to 17-inch displays deliver a lot more viewable area than the old 13-inch units, but bigger screens alone aren't enough. Eliminating screen flicker is also critical. A scanning rate of 72 Hz or higher reduces this flicker, which can tire your eyes.

Because GUIs are notorious computer-power hogs, they also demand very fast video cards to drive these new displays. And we compound the speed problem: Not only do we insist on faster screen redraws in an inherently slower GUI environment, we also want lots of resolution with lots of colors.

Lots of resolution translates into at least Super VGA's 800- by 600-pixel array, and maybe super-Super VGA's 1,024-by-768 matrix. Of course, real performance buffs demand nothing less than 1,280-by-1,024 screens.

And lots of colors means not just the 16 colors of basic VGA but the 256 colors of the VESA-Super VGA standard. I don't want to think about the 32,000 simultaneous colors from a palette of 16 million colors offered by today's 24-bit graphics boards.

Combine, say, a 1,024-by-768 display with 256 colors and you have one heck of a lot of pixels to push around. So even with fast dis-

play cards, screen redraw times go through the roof—along with your patience.

The obvious answer is an accelerated video board, using chips such as the Texas Instruments 340x0 series. These are widely available but still expensive—a thousand bucks or more, at typical street prices, for the ones you want. When you've just spent something over a thousand dollars for a new, larger monitor, the idea of spending another grand for a new video card is distinctly unappealing.

If price is no object, indulge yourself with a fast, accelerated video board.

But if, as for most of us, price is very much an issue, or if you're looking at a corporate purchase of monitors and boards for your workers as you proliferate Windows beyond the early adapters, then consider the *nonobvious* solution: software acceleration.

Some time back I saw a demo of what was to become Panacea's *WinSpeed*. It's a set of improved, much faster Windows video drivers that work with most popular video boards. Panacea worried that you and I would be unwilling to cough up \$50 to \$70, the planned street price, if the product was called a mere video driver kit, so it came to market as a "Display Accelerator for Microsoft Windows." Never mind the hype: I was skeptical, too, but the finished product is a gem.



Panacea claims up to a fivefold speed improvement. I've never gotten that, but I have seen improvements of 100 percent and better with several video boards. That's \$50 well spent.

If you're willing to stop at 800-by-600 resolution with 256 colors, I'm almost certain

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## Jim Seymour

you'll find *WinSpeed* plus a speedy Super VGA board with a meg of video RAM fast enough. If you want to push on to 1,024-by-768 with 256 colors, *WinSpeed* will probably still be enough, but make sure you try the combination for a week or two before buying the hardware.

### BIGGER IS SMALLER?

Before you take any of these leaps beyond standard VGA's 640 by 480 pixels, let me add one little kicker many Windows users don't discover until it's too late: the very small character sizes that you'll get on-screen at high resolutions.

Higher resolution doesn't mean larger, sharper characters; it means *smaller*, sharper characters. For many of us, the tiny screen fonts used in Windows running at 800-by-600 resolution on a 15- to 17-inch monitor are about as small as we can go. Move up to 1,024-by-768 and graphics will be pretty and text may be almost unreadably small.

There are ways around this. Using the IBM 8514A character set is one that's become pretty well known; using high-quality high-resolution display fonts such as the Crystal Fonts supplied with ATI's video boards is another. Even so, you may not like what you see—especially if you have to look at it for several hours a day.

And liking what you see is what displays are all about, isn't it?

I restrain myself to Panacea's 800-by-600 resolution (via a VideoSeven VRAM II card) for most work—and sometimes even fall back to 640-by-480, especially when I have a few people looking over my shoulder. On a top-quality 17-inch display such as the new NEC MultiSync 5FG—or on Radius's new Precision Color 20, the best big (20-inch) color display I've ever seen—800-by-600 looks fine, and I'm happy.

When I'm assembling pages in *Page-Maker*, I switch to 1,024-by-768, to see more on-screen—but invariably return to 800-by-600 when I'm done.

Be wary of cranking your display up to the highest resolution it and your video board will support. The result may be impressive—and unpleasant. And before you spring for an accelerated-hardware video board, try *WinSpeed*. It's no panacea (sorry!), but it's a great answer for most of us. ■



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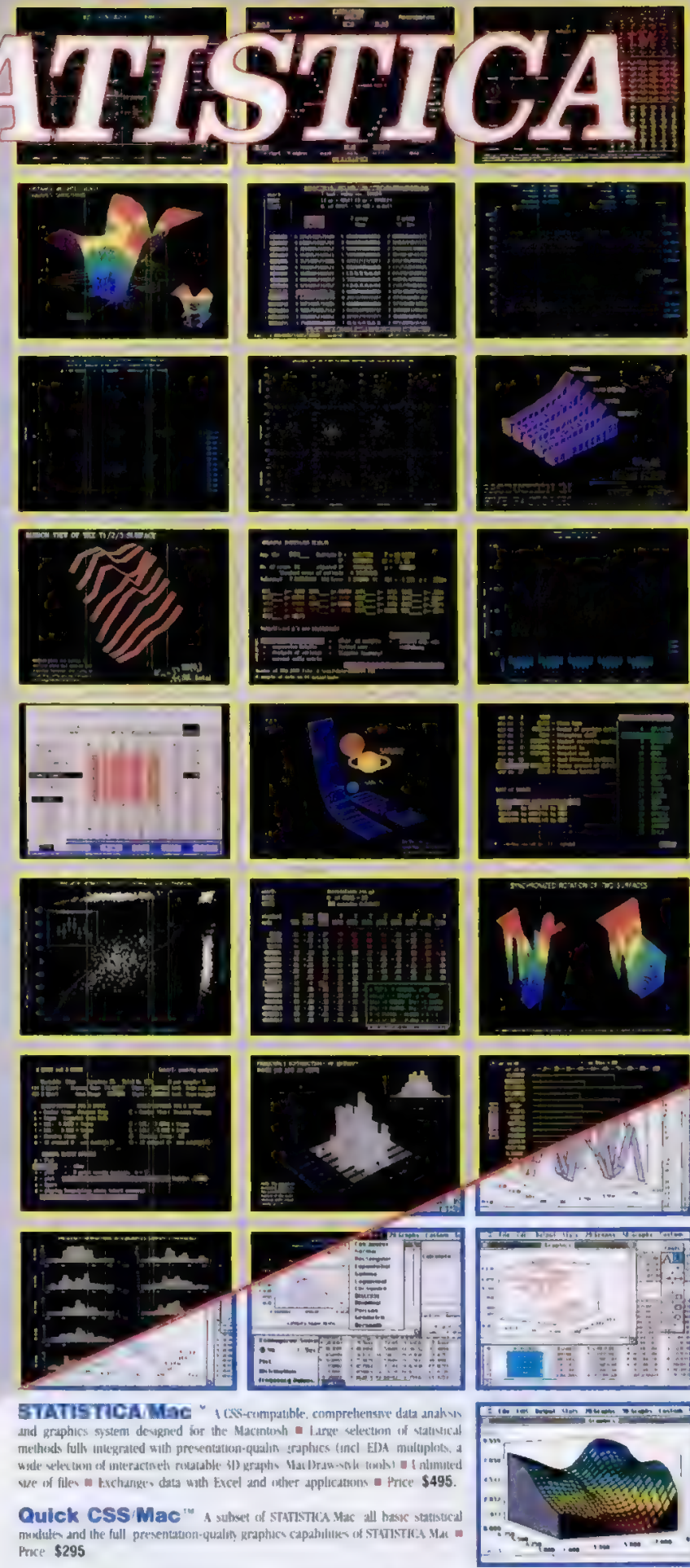
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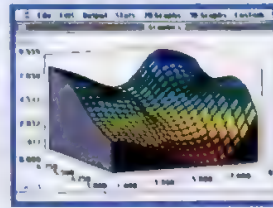
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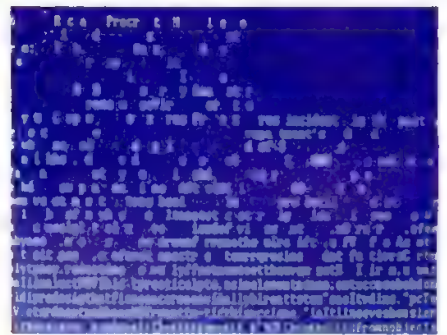
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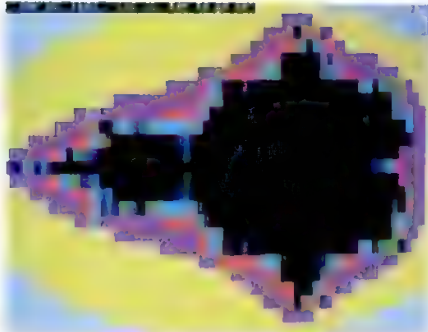


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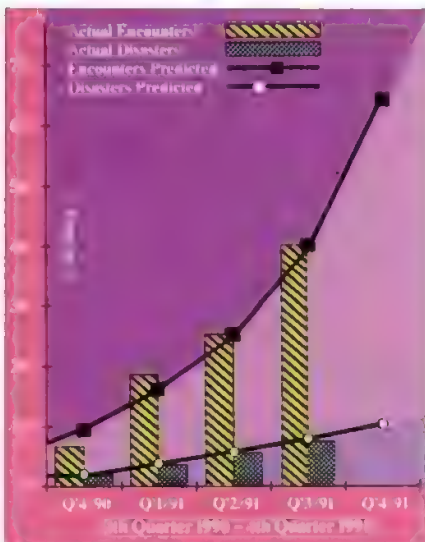


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\*All data from Dataquest/National Computer Security Association virus study (11/91).



Actual and projected percent of organizations experiencing virus disasters each quarter in North America (Dataquest).

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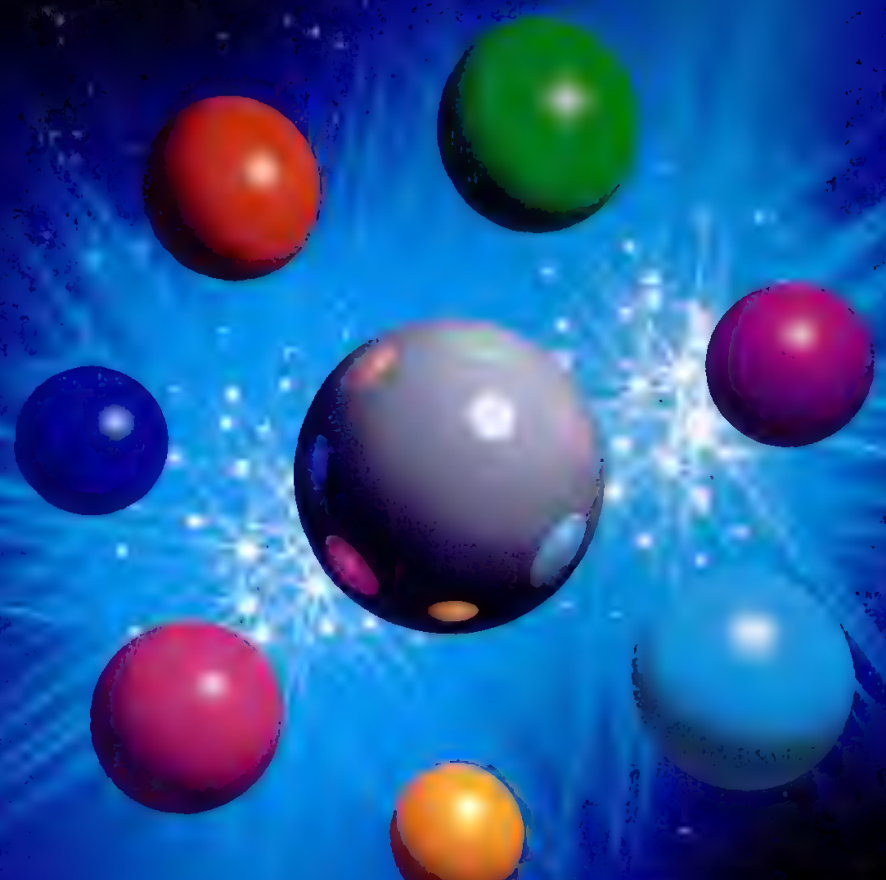
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# William F. Zachmann



## Simulation: The Ultimate Virtual Reality

**The future of virtual reality may lie hidden in the simulation languages of the past.**

In my last column, we looked at the many faces of virtual reality; I said that the "goggles and glove" approach, while popular and newsworthy, was not necessarily where the greatest potential of virtual reality lies. So where do we look? The answer lies in a word that has been around for a long while but thus far has been relatively neglected by the personal computer revolution: simulation.

As early as the 1960s, languages such as GPSS (General-Purpose Systems Simulator), CSS (Continuous System Simulation), DYNAMO SIMSCRIPT and Simula-67 proved that computers could be used to simulate

real-world conditions. These provided powerful facilities to model real-world systems.

Their use, however, was largely confined to specialists. They were

unfamiliar even to most computer professionals. And since end users who might have made use of the power of simulation had no access to these computer systems in the first place, the use of simulation was severely limited.

Perhaps its ivory-tower origin explains why general-purpose simulation tools have been all but invisible for personal computers. The old mainframe simulation languages are all but forgotten. And no one has yet noticed what a tremendous opportunity PC simulation provides for truly new types of applications.

The current wave of interest in virtual reality as well as in object-oriented programming and systems opens the door to a renewed interest in simulation. My guess is that simulation will be where some of the most exciting new PC tools and applications will emerge over the next few years.

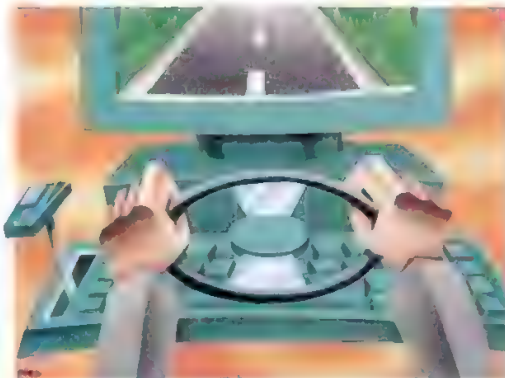
After all, what we today call "virtual reality" is nothing more than the use of computers to create a simulated reality. It is, in effect, simulation by another name and viewed from a somewhat different perspective.

Simulation is also "object oriented," at least in the sense that it involves re-creating objects existing in the real world within the

representational world of the simulated system. In fact, Simula-67, in its use of classes, is generally recognized as a key starting point for object-oriented programming. Bjarne Stroustrup borrowed the Simula-67's concepts when he designed C++ in the early 1980s.

There are many ways in which simulation on personal computers could be of great value. One instant best-seller would be a good LAN simulator. This would allow LAN installers and administrators to simulate network configurations and patterns that would help determine if a proposed network configuration would provide adequate performance. Analysis of traffic flow, whether of cars on a roadway, customers in a store or shopping mall, or goods in a manufacturing process, is another useful analysis.

The basic facilities of these older simulation tools, combined with modern object-oriented languages, can go even further. Simulations all have valuable practical applications, whether they be of customer buying patterns, a health care system's patient and practitioner activity, people in an interaction, a firm or an individual's economic behavior, or software product cycles.



There is a tremendous opportunity for software developers to create a new generation of simulation tools addressing a much broader range of real-world problems than do the limited and cumbersome mainframe simulation languages of the past. Personal computers make it possible to do so in a way that could be used by a wide range of users. Those who develop such tools will open the door for us to examine and to explore real-world systems of all sorts.



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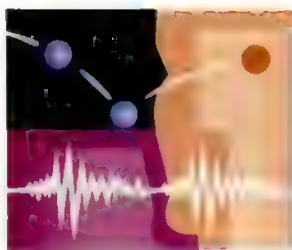


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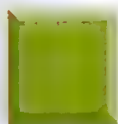




# MULTIMEDIA



PCs AND UPGRADE KITS



MIDI SOFTWARE



AUTHORING SOFTWARE

by Michael J. Miller

Trying to describe multimedia brings to mind the words of Supreme Court Justice Potter Stewart: I can't define it, but I know it when I see it.

It seems as though almost every vendor in the computer industry has some

software or hardware it wants to describe as multimedia. Too often, it's just another Super VGA video adapter or 17-inch monitor. Only recently, we came across one company that was promoting a carrying case with pockets for 5.25-inch and 3.5-inch disks as a

"Multi-Media" Diskette Case.

Obviously, none of those are really multimedia products. Multimedia applications go beyond today's typical combinations of text and graphics software by adding sound, computer graphics (especially animation), and support for

The promise of bringing sound, animation, and digitized video to the desktop PC makes multimedia one of the most exciting technologies around. In the series of articles that follows, we examine the hardware you need to make multimedia work, and the software that makes multimedia work for you.



analog and digital video. They run the gamut from talking reference books to databases that store video images to applications that help you create music. Running these applications requires a multimedia PC—one equipped with extras such as a fast CD-ROM drive and

sound boards capable of MIDI or waveform audio.

Surveying the multimedia landscape can be perplexing. By today's terminology, the software and hardware described in the previous paragraph all qualify as multimedia offerings.

CD-ROM disks that can store large amounts of computer graphics and video and sound boards are generally accepted as multimedia hardware, as are machines and upgrade kits that contain one or more of those components. Even competing multimedia





technologies—hardware conforming to the Multimedia PC Marketing Council's specifications and IBM's Ultimedia machine, for example—share these sound and storage features. A host of sound boards from companies such as Roland Corp. and Turtle Beach Systems also count as multimedia entries; though not yet affiliated with the Multimedia PC Marketing Council or IBM, these products offer MIDI (Musical Instrument Digital Interface) capabilities today, and soon will include waveform audio in their repertoires. NTSC/VGA boards, which also do not fall under any current industry-standard specification, are multimedia devices that allow you to create videotaped presentations combining animation with digitized video. Similarly, the term *multimedia* is generally applied to software that contains sound, animation, or video.

### HISTORY OF MULTIMEDIA

However you define it, multimedia will be one of the key technologies influencing how we use computers over the next few years. In fact, you can look at much of the history of the computer industry as a series of additions of various kinds of information to the user interface, culminating in this grand vision called multimedia.

The first computers dealt only with alphanumeric information. Early personal computers added the ability to work in a graphical mode, but typically only at a lower resolution that was not sufficient for text. Programs such as the early versions of *Lotus 1-2-3* are prime examples of applications bumping up against those limitations: You could display text and numbers in one mode, but had to switch to another mode to see graphs. As graphical user interfaces became popular, first on the Macintosh in 1984 and later on the PC (particularly with the introduction of Microsoft Windows in 1986 and even more so with Windows 3.0 in 1990), we began to see applications that could work with and display both text and graphics simultaneously.

In addition, more environments and

applications began to offer WYSIWYG (what you see is what you get) display of multiple typefaces, styles, and sizes. At the same time, peripherals that more practically allow the input and output of graphics as well as text, such as mice, scanners, and laser printers, began making an impact on the computer industry. The past decade brought us hyperlinking—non-linear navigation through information—and object orientation, which makes complicated operations accessible with point-and-click ease. Once we could easily navigate information and had access to more powerful hardware, we began to want more sophisticated applications that combine analog and digital video, computer graphics, and sound.

### BUILDING ON A FOUNDATION

The basic technology contained in multimedia hardware and software has been around for years in various separate entities. We have had graphical user interfaces such as Windows and mass storage devices such as CD-ROM disks for a long time. A CD-ROM is effectively the data equivalent of a music CD. It can store up to about 600MB of data (one of the reasons why the industry has, at least for the moment, made

the CD-ROM the standard for storing and distributing the massive amount of information required by multimedia applications). Many games and educational programs have taken advantage of sound boards such as Creative Labs' Sound Blaster. We have seen videodisk players connected to computers via pass-through controllers and special controlling software.

Still, having the technology did not immediately create a general multimedia market for the PC platform. The components were designed individually and getting them to work together was a nightmare. User interfaces typically were not designed to take advantage of the multimedia hardware and the components were too expensive. Even more damaging, the

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### THE WORLD OF MULTIMEDIA

Multimedia combines components from many sources. The creation part of the process involves a wide variety of equipment. The playback system requires a CD-ROM drive, an audio board, and speakers, along with a PC with an appropriate interface and display and enough storage.

### AUDIO

1. **CD-audio**, also known as digital audio, has the same format and quality as the disks you play in your CD player at home. CD-audio sounds have been digitized at a sampling rate almost high enough to duplicate reality. The computer is required only to issue commands such as Play to the CD-ROM drive, so speakers can be directly plugged into the drive.

2. **Waveform audio** is also a form of digital audio; but unlike CD-audio, it is stored in a form that the PC can understand and manipulate. Under Microsoft Windows, for instance, a waveform audio file has the extension .WAV. An input device, such as a microphone, cassette player, or CD player, hooks into an audio board with digitizing capabilities; the audio board encodes and stores the sounds on your hard disk. Some audio boards can sample at a high enough rate to create CD-audio-quality files. In playback, the sounds pass back through the audio board, which reconverts them to an analog representation and then sends them out through your speakers.

### STORAGE

6. An application containing digitized audio and video requires a lot of storage space. The PC's **hard disk** is cheap and fast but limited in size.

7. A **CD-ROM** disk provides around 600MB of space in a cheap and easily distributed format, albeit one with slower access than a hard disk. A CD-ROM drive can play traditional CD-audio disks but not the newer disks compatible with **CD-ROM XA** (extended architecture), in which audio and data sectors are interleaved. A multimedia competitor for the PC-centric, CD-ROM-based system is the Philips (Interactive) system, which hooks up to your television and is designed to be an "information terminal" rather than a workstation.





### VIDEO

4. Your PC's **graphics adapter** allows you to display computer-generated text and graphics, such as scanned images and animations. The graphics adapter is a one-way link that runs from your PC to your monitor.

5. In contrast with graphics adapters, **video adapters** come in several flavors and serve a variety of functions, but at the very least they all accept input from some National Television Standard Committee (NTSC) source and display it on your PC's monitor. Some boards serve as videodisk or VCR controllers in much the same way that your PC acts as a controller when playing CD-audio from a CD-ROM drive. The more sophisticated of these boards convert the analog video to digital video so that it can be displayed in a window on your

monitor and you can apply special effects to the images. Some boards serve as a two-way link between the PC and the VCR source, allowing you to record computer-generated images on videotape.

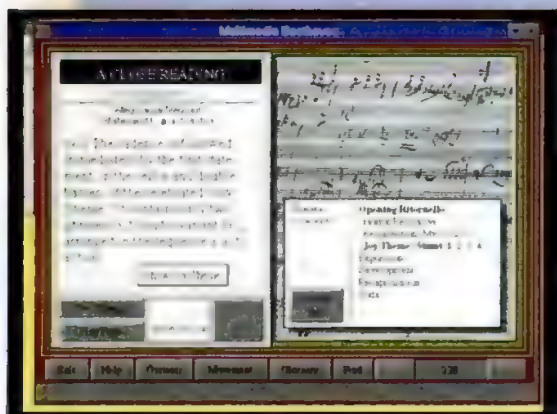
A **video capture board** (also known as a **frame grabber**) will allow you to digitize a single frame from the NTSC source and store it on your hard disk. On the other hand, a **motion video board** (sometimes referred to as a **full-motion video board**) can capture, digitize, and compress multiple frames and store them on some magnetic or optical medium; Intel's Digital Video Interactive (DVI) technology requires such a board. Depending upon the capture technology used, you may require a motion video board to play back the video sequence.





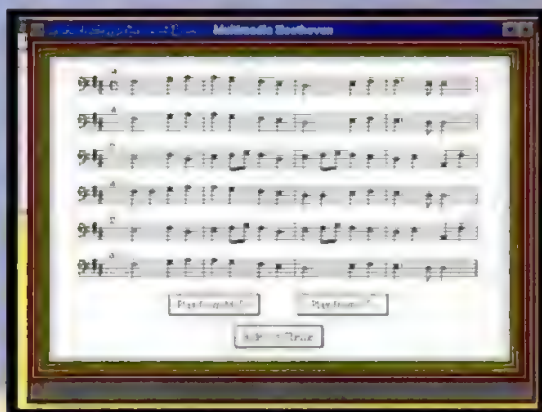


### MULTIMEDIA APPLICATIONS: A Sampler

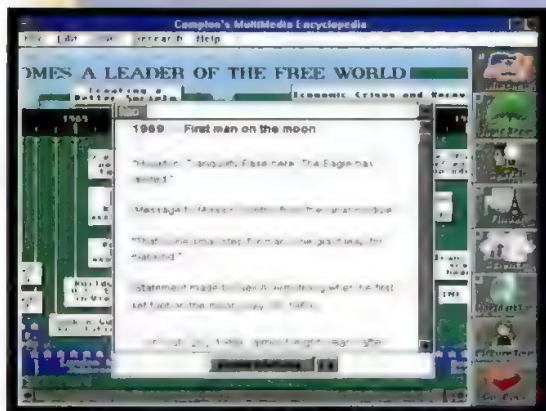
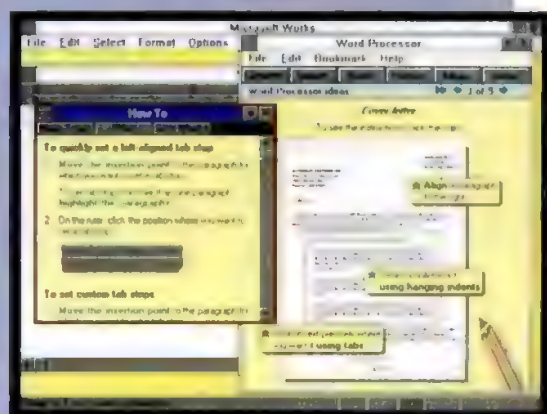
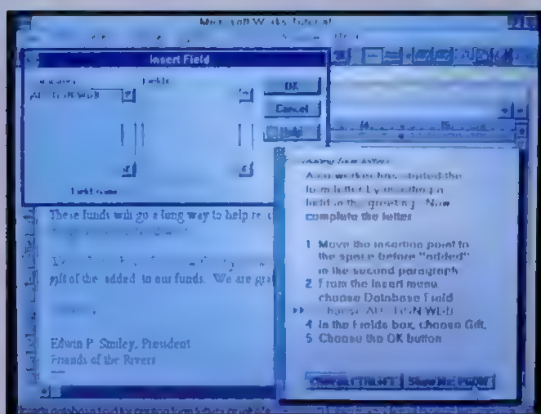


Sometimes sound is the whole point of an application, as with *Multimedia Beethoven: The Ninth Symphony*. This program, created by Robert Winter

and the Voyager Company, features an interactive learning session where you can read about Beethoven's world, explore the structure of the symphony, and see and hear the symphony in detail.

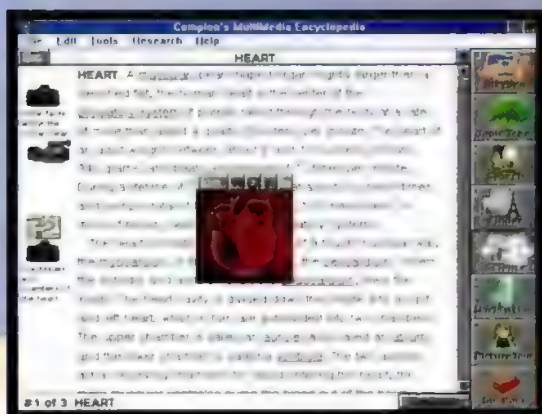


The basic functionality of *Microsoft Works for Windows* does not change with the program's multimedia edition. But the program becomes easier to learn through new "movies" (animations with sound that describe particular features) and through the more detailed, graphical help allowed by the CD-ROM.



Both sound and animation make *Compton's Multimedia Encyclopedia for Windows*, from Compton's New Media, more than just a disk version of a print encyclopedia. You

can hear famous phrases, see animations of how different things work, and jump easily from topic to topic.

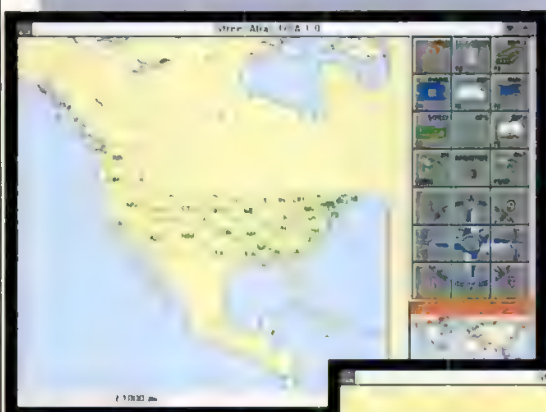




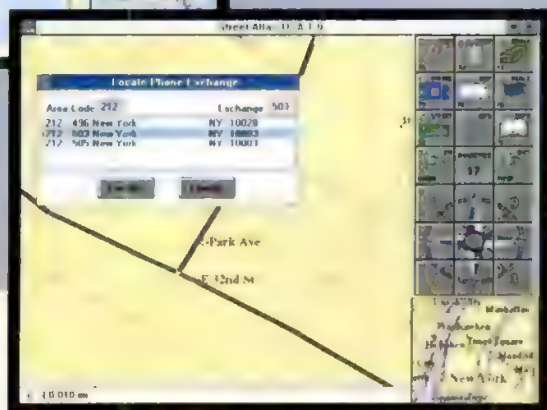
Younger children may like the Voyager Company's *AmandaStories*, based on Amanda Goodenough's tales of "Your Faithful



Camel" and "Inigo the Cat." In each of ten stories, you can point to different objects and direct the actions of the main characters, seeing various animations and playing various sounds.



DeLorme Mapping's *Street Atlas USA* lets you zoom in on various levels of maps. You can locate places, street names, and telephone exchanges and highlight them on the screen.



lack of consistency among those various hardware products did not make it very profitable for software developers to bother creating multimedia applications.

To remedy this problem, a number of vendors joined together to create the Multimedia PC Marketing Council, a marketing group that set the minimum standard for equipment to make it capable of running a common set of multimedia applications. The current standard for an MPC machine requires, among other things, an 80386SX processor or better, a CD-ROM drive fast enough to run multimedia titles, support for MIDI and waveform audio, and Microsoft Windows with Multimedia Extensions 1.0, better known as Multimedia Windows.

Multimedia Extensions is a set of dynamic link libraries (DLLs) that provide links between Windows applications and multimedia hardware. Multimedia Extensions directly supports the three sources of sound information that form part of the MPC specification: waveform, MIDI, and CD-audio. Multimedia Extensions also comes with drivers to support animation. The authoring packages we review in "Author! Author!" in this issue support Multimedia Extensions, providing a means to incorporate sound and animation into multimedia presentations.

Hardware products with the MPC logo essentially carry a promise from the vendor that the product meets minimum MPC standards; software titles bearing the MPC logo bring an assurance from the publisher that the application will work on hardware that meets the MPC specifications. We are just beginning to see the first few machines and upgrade kits that meet MPC criteria—reviewed in "Do Multimedia Upgrade Kits and PCs Meet the Challenge?" in this issue—and the first few applications.

Even as the first generation of MPC machines and applications begin to hit the shelves, other vendors are coming up with alternative standards. IBM's Ultimedia, for example, is the first machine to include an audio capture and playback adapter, CD-ROM XA (extended architecture), and built-in DVI (Digital Video Interactive) video compression. (Reviewed in "IBM Chooses Different Course with its Ultimedia PC," December 17, 1991 and "IBM's Multimedia Solution Goes Forward with CD-ROM XA and DVI" in this issue.) Even the Multimedia PC Marketing Council is busy revisiting the appropriateness of its origi-



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## MULTIMEDIA

### Cover Story

nal specification, since early feedback indicated it did not provide sufficient horsepower.

For the future, developers are setting their sights on even more sophisticated multimedia solutions. These include true color graphics boards, better sound, and more advanced animation capabilities (true color boards can display over 16 million colors simultaneously; reported in "True Color and Plenty of Horsepower," January 14, 1992). Standards are currently evolving in all of these areas, but whether or not they will gain MPC approval is anyone's guess.

Some of the technology is even further away from development. Recently introduced technologies such as Philips Consumer Electronics Co.'s CD-I (CD-Interactive) and other ideas currently on the drawing table will effectively combine televisions and computers: Individual computers will be able to receive complex information with full-motion video. This is likely to build on the work on High-Definition Television (HDTV) currently in progress: HDTV lets televisions receive higher-information signals and it might take advantage of Switched Multimegabit Data Services (SMDS) and the Integrated Services Digital Network (ISDN) technologies that allow high-speed digital transmission of voice, data, and images over existing telephone lines.

With the advent of these new technologies, one thing is clear. Computer applications in the future will continue to spend more and more of their processing time on user interface issues and less on actual data processing.

In early applications, such as *VisiCalc*, up to 90 percent of the processing time was spent number-crunching, with only a small amount spent on the visual appearance of the application. In future applications, those percentages may be reversed. Number-crunching may become less of a computer's task than preparing and presenting the graphics, fonts, sounds, animation, and video that make those numbers more accessible.

#### TODAY'S REQUIREMENTS

While all of that seems a long way off, today's multimedia applications give us a good idea of where we are heading and what kind of equipment we will need.

For even the most basic creation and playback, you will need a personal computer with enough horsepower to handle large amounts of graphics and sound. We recommend at least a 386SX with 4MB of memory. You will also need a graphical user interface for most applications, since

many new PC multimedia applications require Multimedia Windows (MPC-standard upgrade kits and PCs and IBM's Ultimedia system include these elements with the package). Since sound and graphics take up a lot of space, and digitized video takes up even more, you will need a lot of storage; this is why the MPC specification calls for a CD-ROM drive and why IBM includes a CD-ROM XA drive on its Ultimedia system.

Of course, you will need a decent video board to display graphics (a fast Super VGA board, or perhaps one of the new graphics accelerators based on S3's 86C911 chip, would be adequate). For more sophisticated work, you may want a board designed for

connecting your PC to an NTSC (National Television Standards Committee) or PAL (Phase Alternate Line) video source, such as a video camera or VCR. For audio, you'll want at least basic digitized-audio capabilities, and possibly MIDI connections for creating or editing your own music. (Again, sound boards capable of MIDI or waveform audio are part of an MPC upgrade kit or PC; IBM's Ultimedia machine matches the MPC audio specifications in all regards except for MIDI input.)

In terms of prices, expect to pay anywhere between \$850 and \$1,300 for a multimedia upgrade kit with the MPC logo. If you want to get a PC with built-in multimedia capabilities, the 20-MHz 386SX offerings we review in this issue are available for anywhere from \$3,500 to

\$5,000. IBM's Ultimedia system, when it ships, is expected to sell for \$5,995.

Even with all of multimedia's power, you will still find limitations in the current standards and applications. Your processing power will be somewhat limited and you will not be able to store or transmit as much information as you might like. Did you know that uncompressed video images at 30 frames per second could require a data transfer rate of up to 100 megabytes per second? Even with compression techniques that can cut these requirements by 100 times, video needs a lot of storage, which is why you do not see much video in today's applications.

#### THE FUTURE OF MULTIMEDIA

While there are some wonderful multimedia applications beginning to appear, you will not see a huge number of titles until more people have machines ready for multimedia, and people will not buy these machines without compelling applications. The Multimedia PC Marketing Council, with its plan to create a standard platform for applications, is trying to solve this chicken-and-egg problem. As we have seen, IBM is trying to create a competing standard on the PC platform with its Ultimedia. On other kinds of hardware, the Macintosh has already developed a host of multimedia titles and add-ons; Apple is proposing its QuickTime specification as a multimedia programming interface. Commodore has been positioning its Amiga as a multimedia machine. The number of titles that are designed for each of these specifications over the next few months may well decide which, if any of them, becomes a market standard.

At the moment, most of the titles are CD-ROM-based applications for education, entertainment, or reference, or software designed for creating your own multimedia presentations, typically for use in training and sales. The selection of titles may seem limited, but it reflects the expansion of applications that incorporate multimedia from a niche to a much broader market.

In the future, you can expect to see sound and video become more a part of standard applications, such as word processing applications, spreadsheets, and graphics programs. You will be able to insert animations into a word processing program and put voice annotations into a spreadsheet or e-mail message. Expect to see both the display and the transmission of high-resolution video become much

In the future,  
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PC MAGAZINE  
EDITORS' CHOICE AWARD

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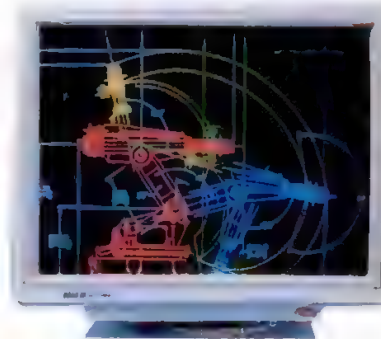
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# When you look at windows, it's not always clear what's behind them.

**PC-mainframe software and a Windows interface is an ideal combination.** After all, by making programs look similar, a graphical user interface makes them easier to learn and use.

But that can be a problem when you're evaluating software. After all, if programs look alike, how do you know which one is the standout?

The answer—look behind the interface. When you do, you'll discover that behind EXTRA!™ for Windows is all the connectivity experience and expertise that has made EXTRA! Extended™ for DOS the best in its class. No wonder EXTRA! for Windows recently won PC Week's "Shootout" of Windows-based connectivity software.

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more common. Who knows, future multimedia applications could involve three-dimensional simulations, with the headsets and goggles favored by the pioneers of "virtual reality."

Don't necessarily expect that there will be one killer application to launch multimedia onto the corporate desktop, though. Multimedia in the corporate world should evolve slowly, starting with sound and gradually becoming part of mainstream applications in much the same way that fancy font usage did.

What we have available today is only a beginning, but it's a pretty amazing beginning.

In the series of articles that follows, we take a look at the current state of the multimedia art. First, we review MPC-standard PCs and upgrade kits in "Do Multimedia Upgrade Kits and PCs Meet the Challenge?" In "MIDI Goes Mainstream," we look at DOS- and Windows-based MIDI sequencers that can prove invaluable aids for the business user who wants to spice up a presentation or grab a trainee's attention in a tutorial video. Finally, we look at three Windows-based authoring packages that harness Multimedia Extensions to put the power of creating multimedia applications into your hands.

Someday, computer users will find that high-resolution graphics and video, animation, and sound capabilities are a part of all machines and all applications. When that happens, we won't see "multimedia" machines anymore; multimedia capabilities will just be a part of the standard platform. ■

*Michael J. Miller is editor-in-chief of PC Magazine.*

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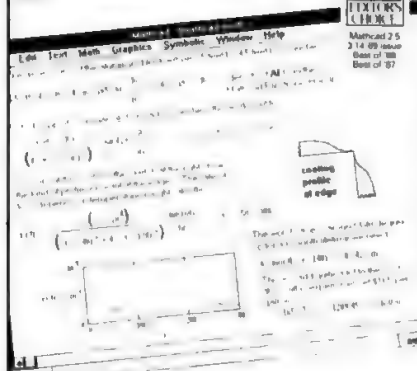
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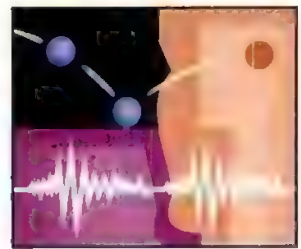
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## MULTIMEDIA

The first MPC upgrade kits and PCs boast fast CD-ROM drives and MIDI and waveform audio. All can run the hottest multimedia applications. Even so, should you wait for the next wave of MPC hardware?

### PCs AND UPGRADE KITS

# Do They Meet the Challenge?

by Charles Petzold

Show people a couple of neat programs for Multimedia Windows and inevitably they will ask, "What do I need to run this stuff?" The answer is simple: "You need a multimedia PC and Multimedia Windows."

A multimedia PC is a lot like any PC but also has specialized hardware—basically a CD-ROM drive and sound and



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# MULTIMEDIA

## PCs and Upgrade Kits

music support. Multimedia Extensions takes the form of additional device drivers and dynamic link libraries, which allow applications to use the multimedia PC hardware in a device-independent manner.

Where do you get a multimedia PC? Well, you can buy an integrated PC off the shelf, or you can add a multimedia upgrade kit to your existing PC. In the reviews that follow, we examine early examples of these two options from Compu-Add Computer Corp., Creative Labs, Media Vision, and Tandy Corp. Expect to pay about \$1,000 for an upgrade kit alone. A PC configured with built-in multimedia capabilities can cost you more—sometimes a good deal more—than a standard PC of the same class; one of the 386SX/20 systems we review here costs \$3,300, and the other was priced at nearly \$5,000. Multimedia PCs and upgrade kits come with the required Multimedia Extensions for Windows. (Microsoft says that Windows 3.1 will have full application program interfaces for the existing Multimedia Extensions but will not have support for CD-ROM drives.)

### THE MULTIMEDIA PC

The multimedia PC is best approached as a minimum-standard hardware configuration required to run Multimedia Extensions. A multimedia PC specification was developed by Microsoft and a consortium of hardware manufacturers, including the vendors whose products are reviewed here, as well as Fujitsu, Video Seven/Headland Technology, NEC Technologies, NCR Corp., Olivetti Office USA, Philips Consumer Electronics Corp., and Zenith Data Systems. The marketing organization they founded is called the Multimedia PC Marketing Council; the standard they developed is called the Multimedia PC (MPC) specification 1.0. (For more information, see the opening section, "Multimedia," to find out how and why the Council was formed.) IBM offers a competing multimedia standard in the form of its Ultimedia machine, which also ships with Multimedia Extensions. (The sidebar "IBM's Multimedia Solution Goes Forward with CD-ROM XA and DVI" goes into more detail.)

The original MPC specification—sometimes called the Level 1 standard—has already been slightly revised. To get maximum market penetration of Multimedia Windows into homes and schools, the original minimum-standard multi-

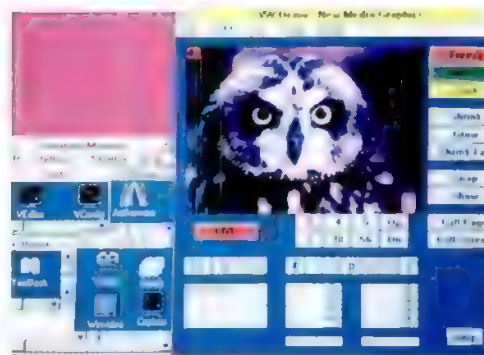
media PC was not a very expensive machine, nor was it very sophisticated.

The minimum standard multimedia PC specified in the original blueprint begins with a 286 microprocessor running at 10 MHz. The standard also includes 2MB of RAM, a 30MB hard disk, and a 1.44MB high-density floppy disk drive.

Already you can see the problem. A

10-MHz 286 with 2MB of memory is barely adequate for running Windows alone. Just recently, the Council upgraded the minimum system to a 386SX; the revision, however, does not specify a clock speed, nor does it raise any of the other requirements. The Level 2 standard (not yet released) will likely specify a 20-MHz 386SX and 4MB of RAM. This is more realistic, but a 25-MHz 386DX machine with 6MB of RAM and at least a 120MB

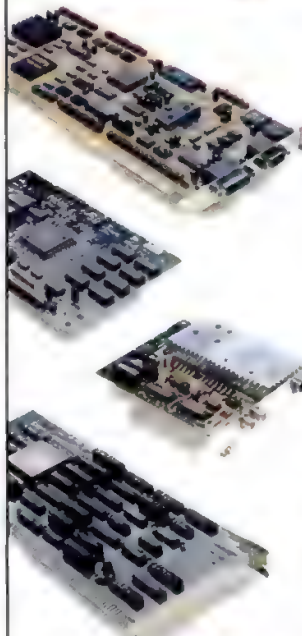
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### THE MPC PATH

by John R. Quain

**A** For most MPC applications, the information read from the CD-ROM drive takes two separate paths. The primary connection conveys data (including .MID and .WAV files) in a digital stream to the CD-ROM controller, typically found on the audio card—a procedure similar to hard disk communication, except that information cannot be written to a CD-ROM disk. The PC then processes the data stream and sends it to the proper components (back to the audio card for sound or out to the video adapter for display).

**B** The second connection from the CD-ROM drive is a 4-pin stereo audio feed to the sound board. This path carries a Red Book audio signal—the type used by audio CDs—which results when one or two DACs on the CD-ROM drive convert digital information into analog information.

**C** The analog Red Book audio is also sent to the CD-ROM's front-panel headphone jack.

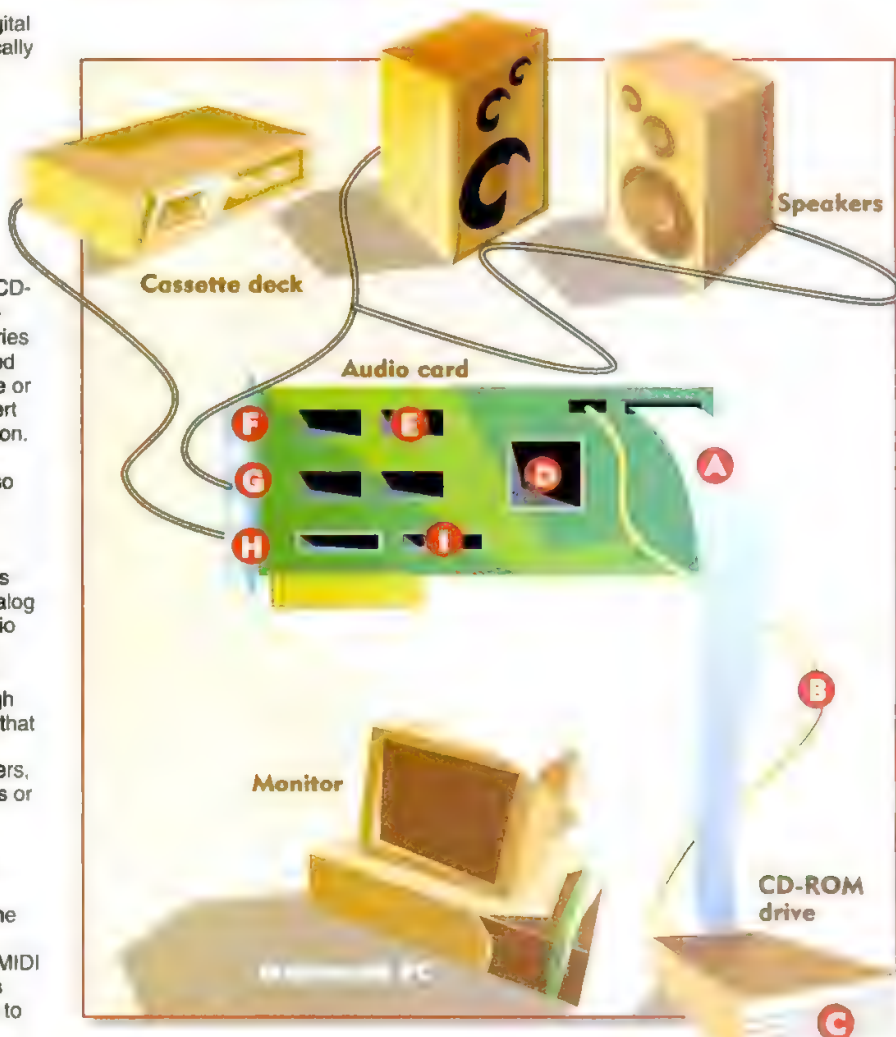
**D** Once the Red Book audio reaches the sound board, it goes to an analog mixer chip. With some boards, the audio then travels to an amplifier chip (which typically adds no more than 4 watts of amplification). It then moves out through the connected speakers. Even boards that provide amplification usually require additional power to drive stereo speakers, so you will need self-powered speakers or an external amplifier.

**E** Audio data files processed by the CPU in .MID and .WAV file form travel back across the system bus to the audio card. The .MID files contain information telling the audio adapter's MIDI synthesizer or dual FM synthesis chips (left and right) what instrument sounds to create. This signal is then sent to the board's analog mixer chip and out through the speakers. Most audio cards use FM chips for MIDI synthesis.

**F** Typically the same .MID data file is sent not only to the FM chips but also directly to the audio card's MIDI port, allowing an external MIDI synthesizer to read the file's contents. On some adapters, the MIDI port does double duty as the MIDI connector and as a joystick adapter for games.

**G** Files with the .WAV extension do not need FM synthesis; they proceed to a pair of DACs (left and right) for analog conversion. Once the conversion is done,

The configuration of an MPC is like a home stereo setup; some components may be connected differently, depending on the equipment you use. This diagram describes a typical MPC upgrade kit or setup, which should include at least a 386SX computer with 4MB of RAM, an 80MB hard disk (or preferably 120MB), a VGA monitor or better, and a mouse.



the signal proceeds to the analog mixer chip and out through your speakers.

**H** There are usually two primary inputs: one for a microphone and one for a stereo sound source such as a cassette deck.

**I** When sound is recorded from the cassette deck (or microphone), the analog signal is converted to digital information by a pair of chips. At this stage the digital information requires considerable storage space; the amount of space depends on the amount of sound recorded and the sampling rate. Consequently, a

relatively low sampling rate is often used, though it is not part of the MPC specification. Sampling a sound at a low rate, a process sometimes called "compression," can take place in hardware or software; after compression, the file can be stored on your hard disk or on some form of removable media. A digital signal processor (DSP) provides the optimal compression method; not many of the reviewed products use DSPs. Such processors can be used for a variety of functions, such as sound manipulation, but they are expensive.



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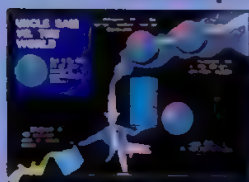


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## MULTIMEDIA

### PCs and Upgrade Kits

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The multimedia-PC Level 1 specification also requires 16-color VGA, which is another controversial aspect. (The Level 2 specification will probably require a Super VGA adapter.) In contrast, 256-color VGA offers applications much more flexibility to display real-world images by using natural colors.

There is one thing you should remember about products bearing the MPC logo: The MPC logo is only a trademark. Products sporting the logo have not been tested by the Council; only the vendors themselves can guarantee product compatibility. System manufacturers can become council members and get full MPC trademark licensing privileges for a \$250,000 fee; upgrade-kit manufacturers can get the same privileges for \$100,000. Manufacturers also have the option of licensing the MPC trademark on a per-system basis.

#### REVIEW CRITERIA

For this review, we look at MPC-trademark desktop PCs and upgrade kits. We required that the ISA-based desktop PCs include a 386SX/20 processor, at least

4MB of RAM, a 100MB hard disk (or whatever the company offers that was closest to that capacity), one 1.44MB floppy disk drive, and a VGA or higher-resolution adapter and display. Of course, we required that the products include a CD-ROM drive as well as MIDI and waveform audio, which are all primary components behind the MPC standard. We also requested that each PC include the two-button mouse that is part of the MPC standard for computers, and that all products meet the MPC specifications for joystick input.

Part of the MPC trademark appeal is that vendors owning the rights to it can display the MPC logo on their hardware. At review time, however, the Media Vision Multimedia PC Upgrade Kit was the only product displaying the logo on its packaging, and CompuAdd had not yet stamped its systems with the logo.

Although microphones are not part of the MPC specification for either PCs or upgrade kits, we asked that the vendors supply them to provide waveform audio input and speakers or headsets for output.

When they could not provide these, we used Roland CS10 speakers. Roland also supplied its MIDI-PC200 keyboard to help us evaluate the units. In addition, we used two CD-ROM offerings—Compton's *Multimedia Encyclopedia* and Microsoft's *Multimedia Beethoven: The Ninth Symphony*—when evaluating the units.

Our filters left us with five products. Three of these are upgrade kits: the CompuAdd Multimedia Upgrade Kit, the Creative Labs Multimedia Upgrade Kit, and the Media Vision Multimedia PC Upgrade Kit. The remaining two products are multimedia PCs: the CompuAdd 320sc MPC 66405 and the Tandy 2500 SX/20 Multimedia PC.

Although MPC-trademark PCs and upgrade kits were not shipping in time for this review, a number of other vendors plan to have such items on the market by the time you read this. GRiD Systems Corp. is planning a PC system; Cardinal Technologies, Video Seven/Headland, Tandy, and Turtle Beach Systems expect to ship upgrade kits. NEC, Olivetti, and Zenith plan to have offerings in both the PC and upgrade-kit arenas. At last report, the multimedia upgrade kit Samsung In-

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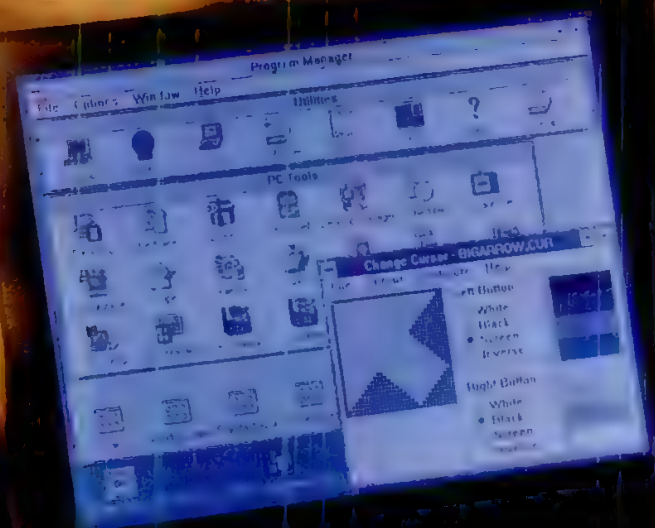
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## WHY MULTIMEDIA PCs DON'T DELIVER THE COMPLETE PICTURE

by John R. Quain

Multimedia is the integration of sound, graphics, and video—full-motion video. So where's the video? Microsoft Windows with Multimedia Extensions 1.0 opens up considerable audio and graphic possibilities, but where are the movie and video-conferencing dialog boxes?

Multimedia Extensions' Audio-Video Interleave (AVI) specification will allow you to play "motion" video from CD-ROM disks. But because of memory and speed limitations, the best that AVI offers is a jumpy sort of animation—not full-motion video. Companies such as CompuAdd and New Media Graphics offer television tuners on a card, but you can't store the video. This is because full-motion video, the sort you are used to watching on your television, uses 30 images or frames per second (fps). That presents some staggering storage and retrieval problems for a PC.

First, the video transmission must be converted from an analog NTSC (National Television Standard Committee) signal—the broadcast form your TV receives—to a digital signal the multimedia PC (MPC) can manipulate. Second, in order to maintain the 30-fps requirement, the signal has to be moved within the PC (or across a network) at a speed that is ten times the ISA bus speed. Third, to take advantage of the digitized video, it is necessary to store the video. A single full-screen color image can require 1.5MB of disk space. At that rate, one second of 30-fps full-motion video would take 45MB of storage. That makes downloading a live sales presentation onto your PC a very expensive and time-consuming proposition.

To overcome the technical hurdles, you need additional hardware. There are two basic options available: NTSC-to-VGA adapters that combine television signals with computer video signals for output to a VCR, and compression/digitization video boards that allow users to store digital video on a PC for precise image manipulation.

### NTSC-TO-VGA ADAPTERS

NTSC/VGA boards offer the simplest solution. Most of these add-in cards can take composite NTSC input (such as that from a regular VCR or camcorder), overlay computer graphics and titles on the live video, and then output the combined signal to a television monitor or VCR. (Other cards include the \$895 VGA-TV GE/O adapter from Willow Peripherals, a division of A.B.V. Electronics, Bronx, N.Y., 800-444-1585; and Truevision's 1MB-equipped \$1,295 VideoVGA board, Indianapolis, Ind., 800-344-8783.) This is accomplished by performing "genlocking," synchronizing the 31.5-kHz VGA signal with the 15.735-KHz NTSC signal.

Some genlocking boards can support an expensive VGA monitor (like the wide-screen models from Mitsubishi) that runs at the 31.5-KHz rate while delivering an output to an NTSC monitor at 15.735 KHz. Most NTSC/VGA boards will only display the combined image on a television monitor. Few of these solutions are recognized by Microsoft's Media Control Interface (MCI), but Truevision has just introduced a compatible \$1,295 adapter. Called the Truevision Bravado, it includes audio functions and is able to display live video in a window on a standard VGA monitor.

The primary advantage of NTSC/VGA boards is that they provide an inexpensive way of making videotaped presentations by combining computer graphics, titles, and animation with full-motion video. Most lack the sophisticated editing features needed to create a really impressive presentation, however. The single exception we know of is NewTek's \$4,995 Video Toaster Workstation PC (Topeka, Kans.; 800-368-5441). The Video

Toaster is really an Amiga PC outfitted with editing hardware and software. (A SCSI-based PC interface and MCI driver will be available by spring; a monitor costs extra.) This hardware combination enables you to create the kind of special effects—such as digital wipes and chromakeys—previously available only in \$250,000 professional broadcast editing suites.

### AUDIO AND VIDEO

#### COMPRESSION BOARDS

Even with all the capabilities of NTSC/VGA hardware, you still can't store and manipulate digitized full-motion video on your MPC. But a new generation of audio/visual compression boards have recently entered the market. These devices use a variety of compression techniques to turn the analog NTSC signal into a digital signal for storage, editing, and display on a PC's VGA monitor. (*PC Magazine* will specifically cover PC graphics image compression in a future story.)

Several compression techniques have been proposed, but only two are currently in use. The first is Intel's Digital Video Interactive (DVI) compression algorithm used in its \$1,895 ActionMedia 750 Delivery board (which plays back full-motion digital video

and true-color stills as well as high-quality audio) and its \$695 add-on ActionMedia 750 Capture board (necessary to capture video from a VCR).

Intel's RTV (real-time video) version of DVI compression allows for compression rates of up to 150 to 1. It manages this by encoding each frame, comparing it with succeeding frames, and then tossing out redundant information (interframe compression). For this reason, this technique is referred to as "lossy" compression. (Audio is

One full-screen color  
image eats up  
1.5MB, making a live  
sales presentation  
a very expensive  
proposition.



compressed to 14-bit samples and interleaved with the video.) When the frames are decompressed for display, some of the original video information is lost, and the resulting 512- by 480-pixel images can be grainy and jerky, making them unsuitable for editing. Furthermore, to store 60 minutes of such full-screen DVI video still requires about 550MB of disk space. (A frame-by-frame DVI compression method is available, but even more storage space is required.)

There are advantages to Intel's system. The DVI protocol is programmable so that it can support other standards and process video at various quality levels. It also can do real-time decoding of video from CD-ROM. And though these images are not like those on your TV, DVI is adequate for video conferencing applications. So far, only IBM and Intel sell DVI hardware. (For more information, see the sidebar "IBM's Multimedia Solution Goes Forward with CD-ROM XA and DVI.")

The second and most prevalent video compression method is JPEG (Joint Photographic Experts Group). Based on a still-image compression method, motion JPEG compresses full-motion video on a frame-by-frame basis (intraframe compression). While JPEG is also a lossy technique, its superior image quality—depending on the amount of compression—makes it more appropriate than RTV for editing. In most implementations, however, it only offers a maximum compression ratio of 20 to 1. Hence, storage is still a problem: 16 minutes of video could consume up to 1GB of storage.

Based on chip sets from LSI Logic, C-Cube Microsystems, and Chips & Technologies, several motion JPEG ISA products are now available. Most provide an interface with Microsoft's MCI and include digital signal processing (DSP) with Motion JPEG compression. VideoLogic's \$2,995 Media-

Station board is MPC-compatible (Cambridge, MA; 617-494-0530), and New Media Graphics Corp.'s \$1,995 Super Motion Compression board is Windows-compatible but requires an additional \$995 Super VideoWindows-CM board (Billerica, Mass.; 800-288-2207).

One company, Fluent Machines (Framingham, Mass.), offers a \$3,995 VSA-1000 JPEG compression board and advanced software called *FluentStreams* (\$495). *FluentStreams* allows bit-level manipulation of individual video frames. Addressing the storage issue, Rapid Technology Corp. (Amherst, N.Y.) offers 1.2GB hard disks (\$2,300), in conjunction with its \$1,695 Visionary Motion JPEG board and \$1,295 Visionary Video 601 Framegrabber (an OEM version of the Truevision Bravado). The disk uses a proprietary disk operating system to maintain high throughput speeds and the contiguous disk space that is necessary for real-time motion-video editing.

Finally, among the various compression contenders on the horizon is a standard known as MPEG (Motion Picture Experts Group). Like DVI compression, MPEG is a lossy interframe compression method. The current MPEG specifications cover only decompression while allowing for a variety of compression techniques. The anticipated benefits of this approach are increased compression rates over JPEG while maintaining compatibility. Complete MPEG products are not yet available, though, and at the earliest the specification won't be finalized until spring.

Though none of these full-motion video alternatives will put Madonna videos on your 200MB hard disk, they do offer ways of completing the MPC picture for sales and training presentations. The tradeoffs are between video quality and storage costs, and the choice you make will depend on your application. ■

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## MULTIMEDIA

### PCs and Upgrade Kits

formation Systems America is planning will not bear the MPC trademark. The Philips Multimedia Personal Computer was shipping at review time, but Philips was unable to provide us with a unit in time for testing for this review.

Some system vendors that haven't bought the rights to the MPC trademark are starting to offer other manufacturers' upgrade kits as an option with their PC systems. For instance, Dolch offers the Media Vision Multimedia PC Upgrade Kit as an option for the Dolch PAC 386-SX/20, and Swan offers the Creative Labs Multimedia Upgrade Kit as an option for the Swan 386SX/20 Power Multimedia System. As multimedia gains in popularity, you can expect more system vendors to offer MPC upgrade kits as an option with their systems.

#### MASS STORAGE WITH CD-ROM

One of the most expensive items in the minimum-standard MPC-trademark PC or upgrade kit is the CD-ROM drive. This requirement is primarily intended to simplify distribution of data-intensive multimedia applications. Any application for Multimedia Windows can be shipped on CD-ROM because all multimedia PCs and upgrade kits have to include a CD-ROM drive. Manufacturers of individual components such as audio boards can claim MPC-compatibility, but they cannot sport the MPC logo because they don't include the CD-ROM that makes for complete MPC capability. (See the sidebar "Building a Multimedia PC Without MPC-Trademark Hardware" for more information on individual audio boards.)

The CDs you use with your stereo system can hold about 76 minutes of music. When used for storing data, CDs can hold about 600MB. Music and data are stored in different formats on a CD, mainly because data requires better error correction. This is one reason why CD-ROM drives cost more than CD players.

You can't put just any CD-ROM drive in a multimedia PC. The MPC specification requires that the CD-ROM drive must achieve a continuous transfer rate of 150 kilobits per second. On our CD-ROM

tests, all the products maintained the specified transfer rate.

**Manufacturers of audio**

**boards can claim**

**MPC compatibility,**

**but they cannot sport**

**the MPC logo, because**

**they don't include**

**the MPC-approved**

**CD-ROM.**

The CD-ROM drive in a multimedia PC must have audio output for playing conventional music CDs. Music and data can be mixed on a single compact disk, but the current CD-ROM standard does not allow music to be played at the same time data is being accessed.

#### WAVEFORM AUDIO:

##### CAPTURE AND PLAYBACK

The multimedia PC must include hardware that captures sounds coming from a microphone and converts them into a digital form, at which point the PC can store them in memory or disk files. These digitized sounds can be sent through the hardware to convert them

back to audio.

Microsoft calls this facility waveform audio, but it is also referred to as digital audio and sampled sound. Multimedia Windows supports a technique called pulse code modulation (PCM) to do this. PCM is the same technique used to record and store music on conventional compact disks.

Despite the fancy name, PCM is conceptually quite simple. To record sound, an analog sound waveform coming through a microphone is sent through an analog-to-digital converter (ADC), which converts the waveform amplitude into a series of numbers. At precise intervals, these numbers are sampled and stored.

For playback, the numbers are sent through a digital-to-analog converter (DAC) at the same sampling rate and are converted back into an analog waveform. This waveform can be amplified and fed into speakers.

#### GOVERNING FACTORS

Two parameters govern the fidelity of PCM—that is, how closely a sound that is recorded and played back will match the original sound source. These two parameters are the sampling rate and the sample size. The sampling rate is a measure of how often sound is converted from an analog waveform to numbers, and it is

measured in samples per second.

The sampling rate governs the highest frequency of sound that can be recorded and reproduced. The sampling rate must be about 10 percent higher than twice the highest sampled frequency. The range of human hearing is approximately 20 Hz to 20 kHz, so the sampling rate used with conventional compact disks is 44.1 kHz.

The minimum-standard multimedia PC is not quite this sophisticated. Instead, it requires hardware that supports sampling rates of 11.025 kHz for recording monophonic sound and both 11.025 and 22.05 kHz for playing back monophonic sound. These rates are  $\frac{1}{4}$  and  $\frac{1}{2}$  the compact disk sampling rate.

The second PCM parameter is the sample size, which is the number of bits used to store the recorded sound's amplitudes. The sample size governs the sound's dynamic range—that is, the difference in volume between the softest sound and the loudest sound that can be recorded and played back.

With a sample size of 16 bits, you get a dynamic range of 96 decibels (dB). The decibel is a logarithmic scale that approximates the response of the human ear to sound volume. A 96-dB dynamic range is almost the difference between the threshold of hearing and the threshold of pain. Conventional compact disks use a 16-bit sample size.

The minimum-standard multimedia PC only requires an 8-bit sample size, and none of the products reviewed here exceed this number. The 8-bit size cuts the dynamic range in half to 48 dB, which is approximately the dynamic range of AM broadcast radio. While adequate for speech, 48 dB is not too good for music. Our performance tests showed that none of the systems we looked at met the standards for frequency response, distortion, or signal-to-noise ratios that high-fidelity stereo amplifiers and CD-players do. But for the business, education, and entertainment applications for which these multimedia upgrade kits and PCs will be most used, it's not likely that adherence to strict high-fidelity standards will be required.

Of course, conventional audio compact disks support stereo. Stereo is not a requirement for the minimum-standard multimedia PC, and indeed the CompuAdd Multimedia Upgrade Kit and the CompuAdd 320sc MPC 66405 cannot generate stereo signals (though they can play stereo CD-audio).

In terms of sampling rates and sample





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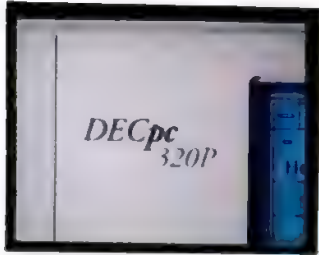
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## Customization Worksheet

Your base system is a: ☐ 286 ☐ 386 ☐ 486 ☐ Other

How many applications will your PC(s) run in a typical workday? \_\_\_\_\_

What best describes the type of work the system will be used for?

(Check all that apply)

- |                                                    |                                                     |                                                                                |
|----------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------|
| <input type="checkbox"/> Word Processing           | <input type="checkbox"/> Desktop Publishing         | <input type="checkbox"/> Scientific Research                                   |
| <input type="checkbox"/> Order-entry               | <input type="checkbox"/> Education                  | <input type="checkbox"/> Software Development                                  |
| <input type="checkbox"/> Database (filing records) | <input type="checkbox"/> Design (CAD/CAM)           | <input type="checkbox"/> E-Mail                                                |
| <input type="checkbox"/> Financial Calculations    | <input type="checkbox"/> Engineering                | <input type="checkbox"/> Other industry-specific applications (please specify) |
| <input type="checkbox"/> Retail Store Management   | <input type="checkbox"/> Industrial Process Control |                                                                                |

How many people work in your group, department or small business?

☐ Less than 10 ☐ 10-20 ☐ 20-35 ☐ More

Is your operating system:

☐ DOS ☐ DOS with Windows ☐ OS/2 ☐ MAC ☐ UNIX™ ☐ Other

Which of the following graphics-oriented applications best describes your needs?

(Check all that apply)

- |                                             |                                            |                                            |
|---------------------------------------------|--------------------------------------------|--------------------------------------------|
| <input type="checkbox"/> Desktop Publishing | <input type="checkbox"/> Realtime Modeling | <input type="checkbox"/> AutoCad           |
| <input type="checkbox"/> CAD/CAM            | <input type="checkbox"/> Animation         | <input type="checkbox"/> Business Graphics |
|                                             | <input type="checkbox"/> Image Processing  |                                            |

## LAN Communication

How many PCs do you have installed? \_\_\_\_\_ From how many manufacturers? \_\_\_\_\_

What kinds of connections does your PC(s) require? (Check all that apply)

- ☐ Links with other PCs in the immediate surroundings
- ☐ Connection to the local area network (LAN) throughout a building
- ☐ A line to a host system in a remote location

What kind of media (cable) is used in your LANs today? \_\_\_\_\_

What is the networking software now being used in your company? \_\_\_\_\_

What kind of host system will your PC communicate with?

☐ DEC ☐ IBM ☐ Other \_\_\_\_\_

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CIRCLE 049 ON READER SERVICE CARD





## IBM'S MULTIMEDIA SOLUTION GOES FORWARD WITH CD-ROM XA AND DVI

by Mitt Jones

Whatever the reason—antitrust concerns, technology preference, strategic positioning, or prideful obstinacy—IBM has refused to endorse or even adhere to the MPC specification. This does not mean that IBM's approach to multimedia is inferior to that of the MPC consortium. Piece for piece and technology for technology, IBM's Ultimedia steps ahead of the MPC to continue IBM's leading-edge position in multimedia.

### ULTIMATE MULTIMEDIA?

Rather than the 286 machine of the original MPC Level 1 specification or the generic SX of Level 1's revision, IBM has a fast, multimedia-specific system at the center of its Ultimedia line. The \$5,995 IBM PS/2 Ultimedia Model M57 SLC, which is scheduled for availability in March, comes with a 20-MHz 386SX/SL processor on an MCA bus, 4MB of RAM, a SCSI host controller, an 80MB SCSI hard disk, a newly improved version of IBM's 16-bit audio sampling sound board (the \$370 M-Audio Capture and Playback Adapter/A), an internal CD-ROM drive, an enhanced system speaker, and front-panel headphone/microphone jacks and volume control. The Model M57 SLC will reportedly ship with three open MCA slots. To the jaded among us, all of this sounds only mildly impressive, but upon closer inspection, the mix offers goodies you won't find anywhere else.

IBM's enhanced 386SX/SL processor—the 20-MHz IBM 386 SLC—promises performance gains of up to 88 percent over an off-the-shelf 20-MHz 386SX; you will appreciate this feature when running multimedia applications. (For more information, see First Looks, *PC Magazine*, December 17, 1991). The 386 SLC owes this performance gain to its on-chip 8K cache. IBM's XGA graphics, which is still interlaced, provides high-performance operation with 65,000 simultaneous colors at 640-by-480 resolution and

256 simultaneous colors at 1,024-by-768 pixel resolution.

The 380-millisecond CD-ROM drive not only matches the MPC specification's sustained transfer rate of 150 kilobytes per second, it also forges ahead with support for the CD-ROM Extended Architecture (CD-ROM XA), which is Microsoft's Level 2 standard for CD-ROM drives: CD-ROM XA allows audio interleaving but not video compression as yet. Of course, you would be hard-pressed to find a current title that uses CD-ROM XA, but its interleaved audio and data sectors and its support for ADPCM (adaptive differential pulse code modulation) audio compression make it a likely successor to vanilla CD digital audio. IBM's M-Audio Capture and Playback Adapter/A matches the MPC audio specifications in all regards but one: It omits MIDI input. But the board goes beyond MPC by providing CD-ROM XA decompression.

The final extravagance is IBM's choice of an operating system—though one must speak in the plural here. IBM will include DOS 5.0; OS/2 2.0, Standard Edition; and Microsoft Windows with Multimedia Extensions 1.0 on the single-installation CD-ROM platter. The system will boot under OS/2, from where users may then run DOS or Windows applications. The presence of Multimedia Extensions means the system should be capable of playing MPC-approved titles, but IBM will not guarantee that. (In fact, a preview system we looked at for our December 17, 1991, First Looks story would not run Microsoft's *Multimedia Beethoven: The Ninth Symphony*.) IBM has announced that it will provide multimedia extensions to OS/2 in the first half of 1992.

### EXPANDABILITY

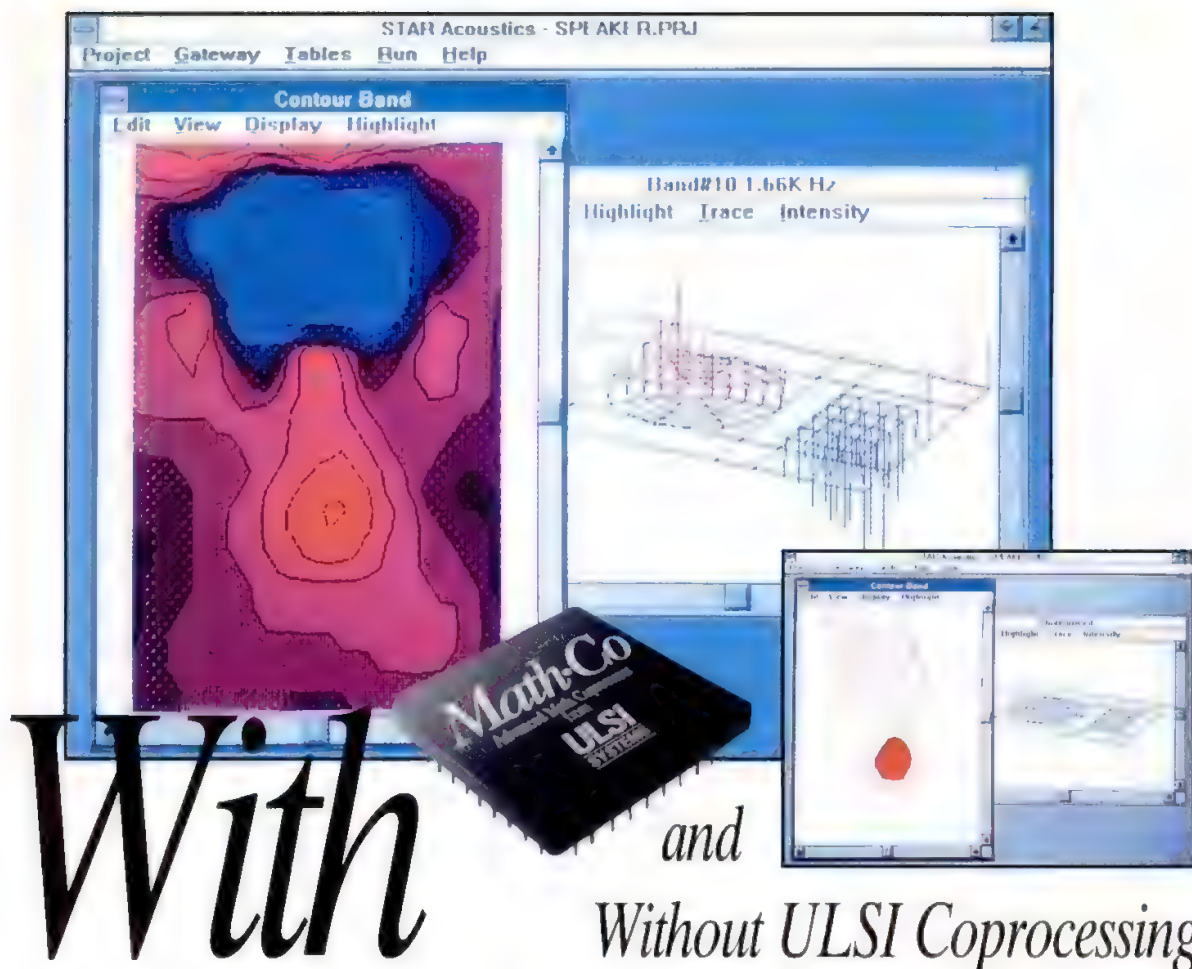
All of this fits well into IBM's broad spectrum of multimedia offerings. The IBM multimedia line includes a \$2,250 enhanced version of IBM's M-Audio Capture and Playback Adapter/A.

Forthcoming options include touch-screen adapters for 12-inch (\$670) and 19-inch (\$850) IBM PS/2 monitors; the \$495 IBM PS/2 TV, an under-the-monitor box which provides 181-channel cable-ready television capability via the system monitor and provides audio and video line inputs and outputs; and the \$1,995 ActionMedia II Display Adapter. In short, the ActionMedia II adapter, available in single-slot versions for both the ISA and MCA bus, use Intel's DVI (Digital Video Interactive) compression and decompression technology to provide motion video along with high-quality still images and audio from a number of sources. (For more information, see the sidebar "Why Multimedia PCs Don't Deliver the Complete Picture.")

IBM has been working hard coming up with applications for its wealth of multimedia offerings. Developers should find all the equipment they need, and a series of multimedia development tools is forthcoming. Businesses can implement the IBM PS/2 TV on a network, giving access across the LAN to broadcast television, recorded video, or live video presentations. Another business solution, Person-to-Person/2, will allow real-time person-to-person desktop conferences: Instead of driving across town to discuss that project with Bob, the two of you can view and listen to each other live, sharing on-screen documents and data. IBM also plans to offer customizable multimedia kiosks or booths for public access and consumer merchandising (such as a touch-screen catalog located in the lobby of a department store).

IBM also plans to continue its multimedia activities in the educational arena. Its most recent offerings here include two in-depth multimedia series: *Columbus: Encounter, Discovery, and Beyond*; and *The Illuminated Books and Manuscripts*, which includes multimedia treatments of five literary works in different forms, including the novel *Black Elk Speaks* and the play *Hamlet*. ■





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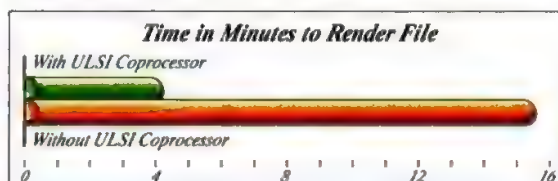
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sizes, the limitations of all the reviewed MPC upgrade kits and PCs mean that you should avoid using expensive speakers; these would tend to make any of the reviewed audio cards' limitations more noticeable.

#### SPACE CONSIDERATIONS

Multimedia Windows does not yet support any compression scheme for waveform audio, so calculating the amount of memory (or disk space) required for waveform audio data is simple: Multiply the duration of the sound in seconds by the sampling rate and the sample size in bytes. Double the result for stereo.

The minimum-standard multimedia PC captures 8-bit samples of monaural sound input at an 11,025-kHz sampling rate. The storage required is 11,025 bytes per second of sound, or 661,500 bytes per minute. For CD-quality sound (a 44.1-kHz sampling rate with 16-bit samples in stereo), you need 176,400 bps, or a whopping 10,584,000 bpm.

Now you see why CD-ROM is a necessary distribution medium for multimedia applications. Waveform audio files can be quite large, and when playing these sounds through the waveform audio hardware, it's necessary to read them continuously from the CD-ROM drive. This is one reason why the MPC standard specifies that the CD-ROM drive must support a continuous transfer rate of 150 Kbps.

#### THE MUSICAL INSTRUMENT

##### DIGITAL INTERFACE

The third and final source of multimedia PC audio output is an electronic music synthesizer using the protocol known as MIDI (Musical Instrument Digital Interface).

In the early 1980s, a consortium of hardware manufacturers developed MIDI to connect electronic music synthesizers and controllers (such as keyboards and electronic wind instruments) to each other and to computers. In less than a decade, MIDI has achieved overwhelming acceptance in the electronic music industry. (For more information, see "MIDI Goes Mainstream" in this issue.)

MIDI is a unidirectional serial interface with a transfer rate of 31,250 bps. Each byte of data requires a start bit and a stop bit, making for an effective data transfer rate of 3,125 bps.

The simplest MIDI connection involves attaching a MIDI cable from the MIDI keyboard's MIDI Out port to the MIDI In



## MULTIMEDIA

### PCs and Upgrade Kits

port of a MIDI synthesizer. When you touch a key on the keyboard, it sends 3-byte Note On and Note Off messages out through the MIDI cable. These messages identify the key that you've pressed or released. The synthesizer responds to these

messages by playing the appropriate notes.

Put a computer in the middle of this configuration and the power of MIDI is magnified immensely. When you play the keyboard, the computer can store the MIDI messages in memory or in MIDI files. This data can be manipulated or combined with other MIDI data. The com-



#### EDITORS' CHOICE

##### ■ Not this generation

None of the reviewed multimedia PCs and upgrade kits is capable enough to earn an Editors' Choice. . . yet. The market is still too immature, and the products have too many rough edges.

For instance, none of the products uses more than 2 operators for its frequency modulation (FM) synthesis (compared with as many as 16 operators on more sophisticated audio boards), resulting in MIDI tones that lack sonic realism. We might ignore the fact that none of the products offers the 16-bit sampling (which makes for high-quality audio output) were it not for the possibility that within a few months, the MPC specification will likely be upgraded from 8- to 16-bit audio.

Not only is the PC market experiencing growing pains, these products have individual quirks and drawbacks. For example, the \$3,300 CompuAdd 320sc MPC 66405 offers fine system performance, but the CompuAdd Multimedia Upgrade Kit it includes features only a single FM synthesizer chip and cannot generate stereo sound. At \$1,069, the CompuAdd Upgrade Kit has the dubious honor of being the most expensive MPC upgrade kit reviewed. The Tandy 2500 SX/20 Multimedia PC cannot match the system performance of the CompuAdd 320sc and also has limited disk and board expansion. At almost \$5,000, the Tandy 2500 SX/20 was also the higher priced of the two PC systems. Admittedly, that price includes 5MB of RAM and a 1,024-by-768 monitor, but plenty of other vendors will sell you a similar configuration that you can equip with a multimedia upgrade kit—and still pay less than

you would for the Tandy PC.

The \$849.95 Creative Labs Multimedia Upgrade Kit boasts some good scores in the audio department, but it cannot compete with the \$995 Media Vision Multimedia PC Upgrade Kit, which offered the best across-the-board performance on the sonic portion of PC Magazine Labs' performance tests. Unfortunately, the Media Vision Upgrade Kit suffers from quirks of its own: For instance, we experienced periodic operating problems, such as system crashes, that didn't plague any of the other products; the unit also suffers from numerous, smaller problems.

Perhaps the best reason not to recommend any of the offerings reviewed here is that by the time you read this, Media Vision will be shipping its \$1,295 under-the-monitor CDPC MPC Upgrade Kit, and Turtle Beach Systems will be selling its own MPC-stamped upgrade kit, the Turtle Beach MultiSound Multimedia Upgrade Kit. Media Vision's CDPC MPC Upgrade Kit will house an amplifier, two speakers, and a condenser microphone. More important, it will offer 16-bit CD-audio performance comparable to that of audio CD players, and a street price comparable to the list prices of some units reviewed here. The Turtle Beach system, priced under \$2,000, will offer 16-bit sampling, full 16-bit bus access, a Motorola DSP, and a full 4MB wavetable instead of Yamaha FM chips. Expect that once we see 16-bit audio from Media Vision and Turtle Beach, other multimedia PC and upgrade kit vendors will have little choice but to follow suit. Our advice: Wait for the next wave.





## BUILDING A MULTIMEDIA PC WITHOUT MPC-TRADEMARK HARDWARE

by Charles Petzold

One of the easiest ways to get Microsoft Windows with Multimedia Extensions 1.0 is to buy an integrated multimedia PC or an upgrade kit displaying the colorful MPC logo, the trademark licensed by the Multimedia PC Marketing Council that denotes full MPC compatibility. MPC-labeled hardware must include a CD-ROM drive, waveform audio hardware, and a MIDI synthesizer and ports. You might also opt for IBM's Ultimedia PC, but you won't get MIDI functionality, nor will IBM guarantee that MPC titles will run on its hardware. (For more information, see the sidebar "IBM's Multimedia Solution Goes Forward with CD-ROM XA and DVI.")

You may not want to invest in a complete multimedia solution, though. If you already have a CD-ROM drive that meets the MPC specifications, you may only want an additional board that supports waveform audio and MIDI. (To find out which non-MPC-trademark drives do this, see the CD-ROM performance tests in this issue.) Such a board will not carry the MPC logo—although if correctly outfitted, it can claim MPC compatibility—because the product does not come with all the other elements of an MPC upgrade kit, such as a CD-ROM drive.

Then again, maybe you already have an MPC-trademark multimedia PC or an upgrade kit, but you want to beef up your waveform audio or MIDI capabilities. This may be particularly necessary if you are a program developer working on multimedia applications. You may want to sample sounds at full CD quality (16-bit samples at a 44.1-KHz sampling rate) for future use but distribute them in your current applications in 8-bit 22.05-kHz or 11.025-kHz formats. Developers may also want to test their applications on a wide variety of multimedia hardware.

Putting together a machine that meets the MPC standard without using MPC-logo hardware is not recommended to the casual user. There can

be a variety of problems related to I/O-port addressing, hardware interrupts, and installing device drivers. But it makes perfect sense for power users and developers. In fact, Microsoft's Multimedia Development Kit includes Multimedia Extensions with drivers for several popular sound boards that don't necessarily come as part of an MPC-approved package: the Sound Blaster (from Creative Labs), the AdLib Sound Card, and the Roland MPU-401.

The \$169.96 8-bit Sound Blaster has been supported by Multimedia Windows from the very beginning. Indeed, the minimum-standard multimedia PC waveform audio and MIDI capabilities are based to a large extent on this board. The MIDI synthesizer on the Sound Blaster is compatible with the popular AdLib Sound Card. The Sound Blaster has the virtue of being relatively inexpensive (its higher-end sibling, the Sound Blaster Pro, sells for \$299.95). It is also useful for developers who want to hear how their applications sound on simple minimum-standard hardware.

One board more recently introduced does not yet have device drivers for Multimedia Windows but will have them soon. The \$229.95 Covox Sound Master II is an integrated sound board containing waveform audio hardware, a MIDI FM synthesizer compatible with the AdLib Sound Card, and a cable that provides MIDI In and MIDI Out ports. The board even comes with a pair of tiny speakers.

### MORE ADVANCED CAPABILITIES

A very exciting sound board still being beta tested at the time of this writing is Turtle Beach Systems' MultiSound board, expected to ship in February. This board can record and play back waveform audio in stereo at CD quality (16-bit samples at 44.1 kHz). It also includes a MIDI synthesizer that allows 32-part polyphony. To avoid the need for an external sound mixer, the \$995 MultiSound board can accept an

audio output jack from a CD-ROM drive and mix the CD audio output with the waveform audio and MIDI sound sources. Turtle Beach is also planning to ship in February its MPC-trademark Turtle Beach MultiSound Multimedia Upgrade Kit, which uses this card and is priced at \$1,795 for the internal CD-ROM version and \$1,895 for the external version.

Roland—a big name in electronic music synthesizers—has a new MIDI-only board: the SCC-1 GS Sound Card. This \$499 board has a complete stereo MIDI synthesizer with 24-voice polyphony, as well as MIDI In and MIDI Out ports, so you can connect it to external MIDI controllers and external synthesizers. This card has the same great sound-generation hardware found in Roland's recent SC-55 Sound Canvas external MIDI synthesizer.

The GS in the product name stands for the General MIDI Mode specification that Multimedia Windows uses for MIDI voice mapping. The interface of the SCC-1 GS Sound Card is compatible with the popular Roland MPU-401 board, and the SCC-1 synthesizer can also be switched into a mode that emulates the voice mappings of the Roland MT-32. Roland promises both MIDI and waveform capabilities in an upcoming product.

Many inexpensive MIDI synthesizer boards (such as the one found on the Sound Blaster) use a technique called frequency modulation (FM) synthesis to create musical tones. It involves the digital generation of sine waves that modulate each other's frequencies in various ways, creating overtones that sound musically interesting, if not exactly like real instruments. The MIDI synthesizers on the Roland SCC-1 and the Turtle Beach MultiSound boards, on the other hand, use digitized samples of real musical instruments to generate sounds. Although it requires lots of on-board ROM to store the digitized sounds, this technique provides much more realistic-sounding instrument voices. ■



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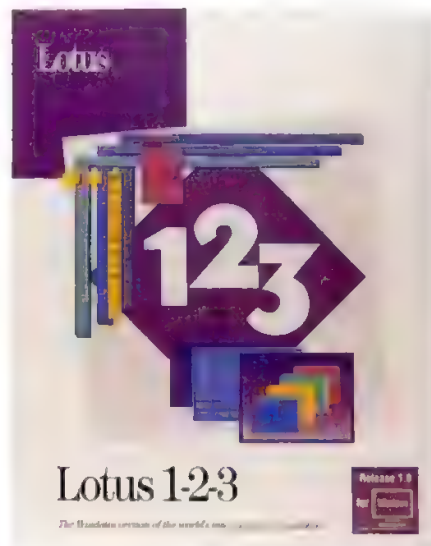
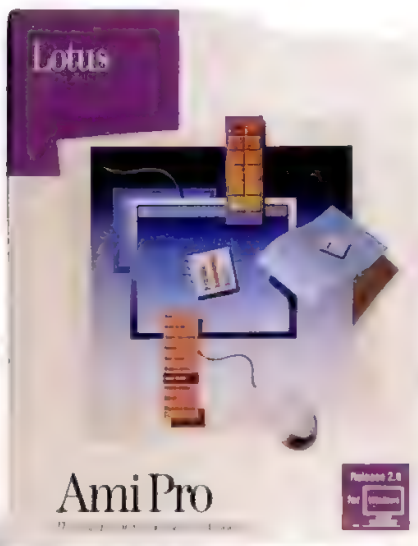
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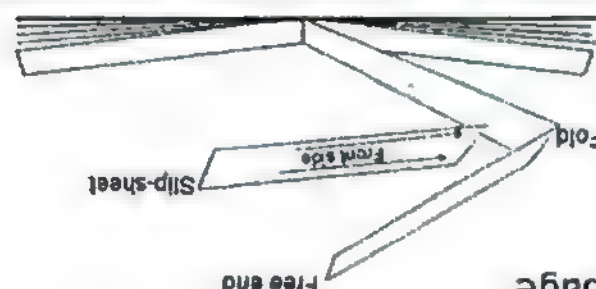
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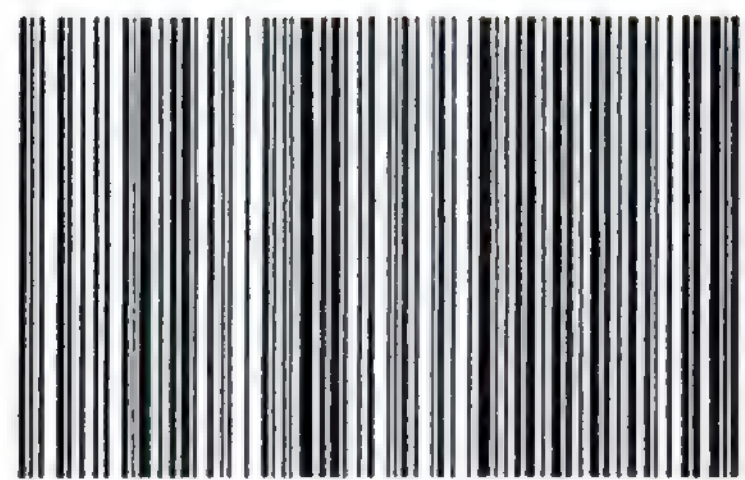
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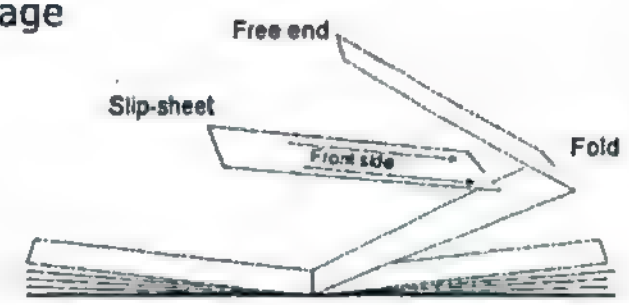


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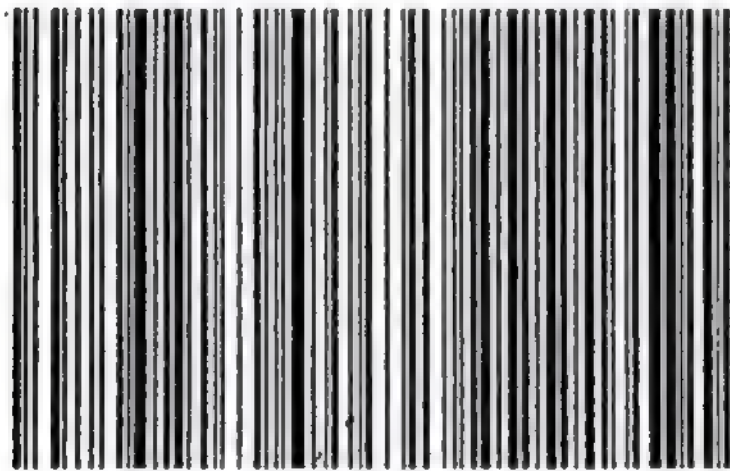
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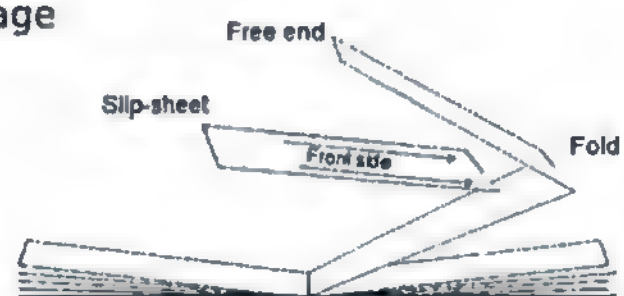
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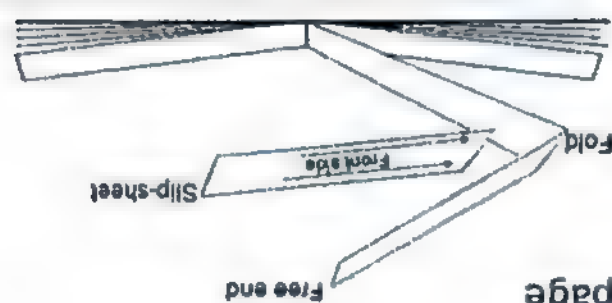
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Inverted Foldout slip-sheet

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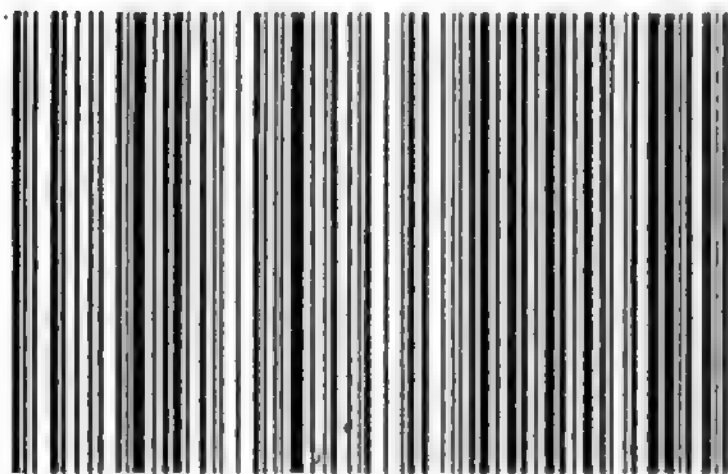
1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





1. Follow instructions on the other side

Inverted Back



GbsSlpBack-0018

Back

1. Follow instructions on the other side

that's ZEOS Value. Speaking of which, here's another industry first you will definitely benefit from.

### **ZEOS ANNOUNCES: BUILT IN SURGE SUPPRESSION!**

Right now, ZEOS is proud to announce that we've taken our top-of-the-line *300 watt* supply and added a *built in surge suppressor*. Building the surge suppressor right into the power supply increases reliability and helps protect your investment. We wonder how long it will take for the rest of the industry to catch up. And while ZEOS is giving you critically important features like these, we add yet another.

**UL® Listing!** As *PC Magazine* said, UL Listing is "one of the few forms of peace of mind you can buy." Every ZEOS system is Underwriters Laboratories Listed. This means your entire system (not just the power supply) has met the stringent safety requirements of Underwriters Laboratories. Not only that but your

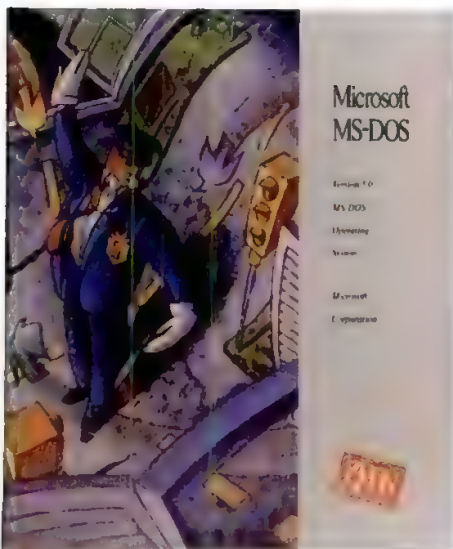
ZEOS UL® listing says a lot about quality too. UL safety listings are something many of our competitors simply don't (or can't) provide you. At ZEOS quality and safety are important to us. *You are important to us!*

### **24-HOUR A DAY TOLL FREE TECHNICAL SUPPORT.**

The importance of having you as a customer shows in many other ways as well. For example, at ZEOS we believe supporting *you* should be more than a part time proposition. As *PC Magazine* said, "Insist on a good service and support package. Expect...24-hour seven-day-a-week support." We've been saying that for years. In fact, it was ZEOS that invented *24 Hour a Day Toll Free Sales and Technical Support*. Our customers tell us they love it. And you will too. Any time you need assistance a ZEOS technician is only a phone call away.

With ZEOS you can have complete

# Great Prices. Lo



*For a limited time only, in addition to Microsoft® DOS 5.0, Windows and a MS mouse, every ZEOS Windows System also includes Lotus 1-2-3 for Windows plus Ami Pro 2.0 plus Adobe Type Manager. No additional charge! You're going to love it!*



## ZEOS COMPLETE SYSTEM PACKAGE #1

- The Processor and Speed of your choice plus future upgradability!
- 1MB of High Speed RAM, expandable to a system total of 32MB right on the motherboard.
- 42MB High Speed IDE hard drive with its own cache.
- 1.2MB or 1.44MB Teac® floppy drive.
- ZEOS 14" flat screen Hi-Res amber monitor with Tilt/Swivel Base.
- Shadow RAM and EMS support for enhanced performance.
- ZEOS/RS 101 key SpaceSaver keyboard.
- Two Serial, one Parallel & one Game Port built right onto the motherboard.
- 7-16, 1-8 bit expansion slots. 80387 math co-processor support for '386 systems.
- Rugged ZEOS SpaceSaver case with twin cooling fans for added reliability and product life.
- Seven drive bays and our custom 300 Watt power supply with built-in surge suppressor!
- Includes ZEOS 24 Hour a Day Toll Free Technical Support and Customer Satisfaction package.

## INCREDIBLE ZEOS PACKAGE #2

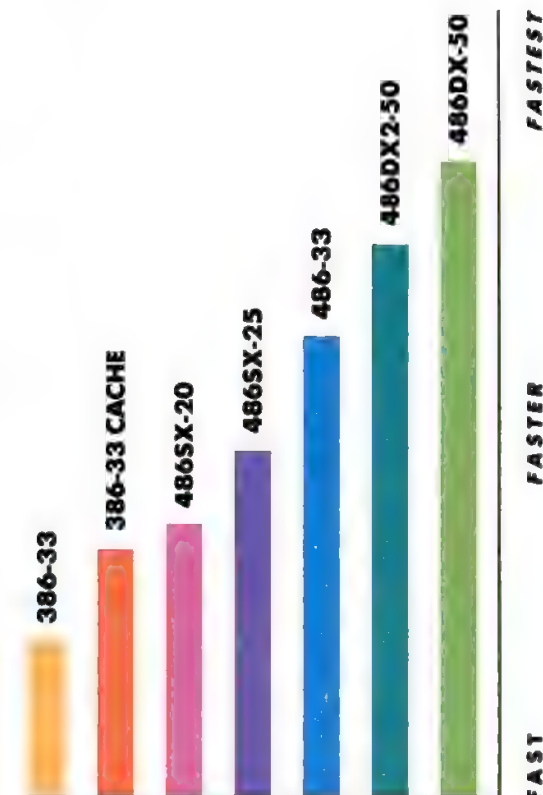
We take Package #1 and upgrade your ZEOS Modular System to include:

- 2 full Megabytes of Rip-roaring RAM.
- Our incredible 107MB IDE hard drive with its own built-in cache.
- Both the Teac® 1.2MB and 1.44MB floppy drives.
- Diamond SpeedStar Hi-Color VGA card/1MB RAM & Sierra DAC.
- ZEOS 14" High Res VGA Mono Monitor with Tilt & Swivel Base.
- Lotus 1-2-3 for Windows, plus Ami Pro 2.0, plus Microsoft Windows and DOS 5.0, plus a genuine Microsoft mouse!

Now, ZEOS lets you pick exactly the power you want for the price you want to pay. Simply match the processor with the package configuration and you have your price. Or if you wish, we will custom build any system to your exact specifications.

And don't forget, with every ZEOS Windows System (packages 2, 3 and 4) you'll also receive Lotus 1-2-3 for Windows plus Lotus' new word processor for Windows *Ami Pro 2.0*. The Lotus software alone carries a suggested retail of over \$1,000 and even street prices are over \$700. Yet we're giving it to you at *no additional charge!* That's ZEOS value.

No doubt about it. ZEOS has broken the price/performance barrier with these great new upgradables,



### Z-SPEED GRAPHOMETER

Let the "Z-Graphometer" help you pick the processing power that's right for you. The comparisons are easy to make. Fast, Faster or Fastest!

Or  
Customize, Customize,  
Customize!  
Just Tell Us and  
We'll Do It.

# Pick Your Power!



and you're the beneficiary. Incredible power, upgradability, and free software. What more could there be? From ZEOS, lots more.

Because your new ZEOS system is not only fast, it's absolutely loaded with features. Like our 300 watt power supply with *built in surge suppression*, eight expansion slots, twin cooling fans for even more reliability plus our unique seven bay SpaceSaver case. And, every ZEOS system is UL\* listed.

And don't forget you're also receiving 24 Hour a Day Toll Free Technical Support, our 30 day Absolute Satisfaction Money Back Guarantee, Express Parts Replacement and more. So go ahead.

Pick your Power, your Package, and your Price and give us a call. Your friendly, expert ZEOS Systems Consultant is ready to answer any questions you may have. *Call Now Toll Free 800-423-5891.*

**PACKAGES 2, 3 AND 4 INCLUDE LOTUS BUNDLE!**

|                  | Pkg. #1 | Pkg. #2 | Pkg. #3 | Pkg. #4 |
|------------------|---------|---------|---------|---------|
| <b>386-33</b>    | \$1395  | \$1895  | \$2395  | \$2895  |
| <b>486SX-20</b>  | \$1595  | \$2095  | \$2595  | \$3095  |
| <b>486SX-25</b>  | \$1695  | \$2195  | \$2695  | \$3195  |
| <b>486DX-33</b>  | \$1795  | \$2295  | \$2795  | \$3295  |
| <b>486DX2-50</b> | \$1995  | \$2495  | \$2995  | \$3495  |
| <b>486DX-50</b>  | \$2195  | \$2695  | \$3195  | \$3695  |

*Add \$200 to any price for a 128K cache. 486DX-50 SpaceSaver case has 6 bays.*

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When you buy from ZEOS you have a wide variety of payment options. We accept MasterCard, VISA, American Express and Discover cards, or if you wish we can ship COD.

We also have our own ZEOS credit card, the "Z-Card." The Z-Card allows you to charge your ZEOS purchases just like a MasterCard or VISA. There is a low consumer rate and there is no annual fee. We can send you an application or you can apply right over the phone. Our special Toll Free application number is 800-421-8942.

ZEOS also offers a terrific leasing program for businesses. The rates are lower than those charged by most of the others in our industry. We will promptly mail or fax you an application on request. Just give us a call at 800-423-5891.

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**INCREDIBLE ZEOS PACKAGE #3**

Add even more memory, a larger drive. And more Savings! You now receive:

- 4 full Megabytes of Ultra High Speed RAM.
- Our fast 130MB IDE hard drive with built in cache.
- Teac® 1.2 & 1.44MB FDD'S!
- Diamond SpeedStar Hi-Color VGA card/1MB RAM (32,000+ colors)!
- ZEOS 14" 1024x768 Non-interlaced VGA Color Monitor w/Tilt & Swivel.
- Lotus 1-2-3 for Windows, Ami Pro 2.0, Microsoft Windows, DOS 5.0 plus a Microsoft mouse!

**THE ULTIMATE ZEOS PACKAGE #4**

Now, Memory goes to 8MB and the drive to 210MB. PC Magazine Editors' Choice as a 486DX-33 Vertical!

- 8 full Megabytes of High Speed RAM.
- Your screaming 210MB IDE hard drive with its own built-in cache.
- Teac® 1.2 & 1.44MB FDD'S!
- Diamond SpeedStar Hi-Color VGA card/1MB RAM (32,000+ colors)!
- ZEOS 14" 1024x768 Non-interlaced VGA Color Monitor w/Tilt & Swivel.
- Lotus 1-2-3 for Windows, Ami Pro 2.0, Microsoft Windows, DOS 5.0 plus a Microsoft mouse!

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If you thought power like this was out of your budget, take another look. While many of the others don't even offer 50MHz power, you can own the new ZEOS 486DX2-50 starting *complete for as low as \$1995!*

Starting at \$1995, you can select from any of four money saving ZEOS System

100+ megabytes, applications just don't seem to be shrinking (however, before you go too wild, remember you can always add more drives). Both of our Packages #3 and #4 incorporate these suggestions.

Certainly another option you may want to consider is our Vertical case. This heavy

#### ZEOS POWER GRID FOR THE 486DX2-50

Apply The "Zeos Power Grid" To Match Your 50MHz Needs: Add \$200 for 128K cache. Prices shown are for Intel 486DX2-50 CPU, for 486DX-50 add \$200.

Pkg. #1 Only \$1995  
Pkg. #2 Only \$2495  
Pkg. #3 Only \$2995  
Pkg. #4 Only \$3495

|                     | Intel 80486DX2-50MHz | Upgradable CPU | 1MB High Speed RAM | 2MB High Speed RAM | 4MB High Speed RAM | 8MB High Speed RAM | 42MB HDD, Fast IDE | 107MB HDD, Fast IDE | 130MB HDD, Fast IDE | 210MB HDD, Fast IDE | Teac 12 Floppy Drive | Teac 144 Floppy Drive | 14" Hi Res TTL Monitor | 14" VGA Mono Monitor | 14" VGA Color 1024 x 768 NI | Monitor Tilt & Swivel | Hercules® Graphics Card | Hi-Color VGA Card | Sierra DAC | Shadow RAM/EMS Support | ZEOS/RS 101 keyboard | 2 serial, 1 parallel, 1 game port |
|---------------------|----------------------|----------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|----------------------|-----------------------|------------------------|----------------------|-----------------------------|-----------------------|-------------------------|-------------------|------------|------------------------|----------------------|-----------------------------------|
| Pkg. #1 Only \$1995 | ■                    | ■              | ■                  | ■                  | ■                  | ■                  | ■                  | ■                   | ■                   | ■                   | ■                    | ■                     | ■                      | ■                    | ■                           | ■                     | ■                       | ■                 | ■          | ■                      | ■                    | ■                                 |
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Packages. Or, if you wish, let us custom build your hot new 486-50 to your exact specifications.

#### WHAT SHOULD I GET?

How should you configure your new ZEOS 486-50? Of course the best answer depends on your needs and what you plan to use your new system for. But never before has so much power been available to everyone at such a low price. Our suggestion would be to consider investing in two areas when you buy your new 50MHz system. The memory and drives. Particularly the memory.

From what we're hearing, memory will be important with the new operating systems debuting later this year. We would strongly recommend at least 4 megabytes, eight if it's in the budget. As for drives, think in terms of



# Your 486

## ZEOS Breaks the '486-

duty case holds more drives than most others and has a top notch power supply and plenty of cooling.

It really is quite a buy. The power supply is the *TurboCool 300 watt* unit (check the retail price of the power supply

alone if you really want to see what a good deal you're getting). It's well worth considering.

#### **YOUR ZEOS EXTRAS. NO EXTRA CHARGE.**

And don't forget, if you purchase a ZEOS Windows system we'll also include

746, 18 bit expansion slots  
300 Watt Power Supply  
Built in Surge Suppression  
ZEOS SpaceSaver Case  
Two cooling fans  
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100's of Other Options  
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*Consider the Vertical Option. We can build your new upgradable system in our eight bay vertical case. It comes complete with the 300 watt TurboCool power supply and two cooling fans. Add only \$150.*

*Lotus 1-2-3 for Windows plus Ami Pro 2.0 with Adobe Type Manager. You'll be getting all the other ZEOS extras too.*

If you don't go with the Vertical case, we'll send your 486DX2-50 in our seven bay SpaceSaver case (the 486DX-50 has 6 bays); it's complete with our top quality 300 watt power supply, *built-in surge suppressor*, and *two* whisper quiet cooling fans.

Remember too, ZEOS also provides you with 24 Hour Support, our 30 Day Money Back Guarantee, One Full Year Limited Warranty and our Express Parts Replacement Policy.

Ordering your new ZEOS 486DX2-50 is really quite easy. Simply pick up the phone and

give us a call. You're going to love your new ZEOS '50. And that's a guarantee! Call now Toll Free 800-423-5891.

# DX2-50!

## 50MHz Price Barrier!



# Computers Now! <sup>SM</sup>

## Take Your Pick. We'll Ship Today!

**RIGHT NOW. GUARANTEED!\***

Yes, we can ship your new ZEOS '386 or '486 today! We've built up an extra supply of the hottest selling computers in America in their most popular configurations.

Here's how it works. We have these incredible ZEOS '386 and '486 color VGA systems pre-built and ready to ship. While supplies last, we will ship any of these systems to you *the day you order* subject to these conditions:

1. Your order must be received by 1PM Central Time M-F.
2. Credit Cards are subject to authorization.
3. Orders must be for ZEOS '386 or '486 systems configured as shown here. Any other systems or upgrades are custom built and will take slightly longer.



**Yes! We can ship  
your new ZEOS system  
Right Now!  
Place your order  
by 1:00 PM Central  
Time and we'll ship  
today. Guaranteed!\***

### **\*OUR GUARANTEE TO YOU:**

If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it at *our expense* as soon as it is ready.

This offer is good only as long as these pre-built systems remain in stock; please give us a call to verify availability. This offer does not apply to other ZEOS systems or custom configurations.

### **IMMEDIATE SHIPMENT IS ONLY PART OF THE STORY.**

These are not just any computer systems. They're the high performance, high quality ZEOS *upgradable* systems. Packing all the ZEOS value that has won PC Magazine Editors' Choice—*nine times!*

So why not give us a call right now. If we hear from you by 1:00 this afternoon, we'll get your new system on the way to you today! Call now Toll Free 800-423-5891.

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**Our most popular '386 & '486 packages! 128K Cache, 130MB Drive, 4MB Memory and More. Ready to ship today!**

**'386-33 ONLY \$2595.**

**As a '486-33 ONLY \$2995!**

- Upgradable CPU module allows you to change processors as your computing needs change!
- Ultra high speed Zero-Wait 128K SRAM Cache.
- 4MB of Zero-Wait DRAM, expandable to a Total of 32MB on the motherboard.
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- Lotus 1-2-3 for Windows, *plus* Ami Pro 2.0 with Adobe Type Manager, *plus* Microsoft Windows and DOS 5.0, *plus* a genuine Microsoft mouse!
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as your credit line is established!\*

Please complete all appropriate sections, *providing at least two years residence and employment history*. **THIS IS NOT A CREDIT AGREEMENT!** One will be sent to you upon authorization of an account. (This Form Must Be Signed To Process Your Order.) All Financed Purchases Are Subject To Credit Approval. **If You Have Any Credit Questions, Please Call 800-421-8942 For Assistance. Thank You!**

A married person may apply for individual credit. I am applying for (please check appropriate box):

- ☐ **JOINT CREDIT** with another person. Complete entire application.
- ☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.
- ☐ **INDIVIDUAL CREDIT.** Do not complete Section C.\*\*

\*\*If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

**NOTICE TO WISCONSIN APPLICANTS:** YOU MUST DISCLOSE YOUR MARITAL STATUS:

☐ married ☐ unmarried ☐ legally separated

### A. YOUR PERSONAL INFORMATION

Name \_\_\_\_\_  
Home Phone (\_\_\_\_\_) \_\_\_\_\_  
Soc. Sec. No. \_\_\_\_\_ Date of Birth \_\_\_\_/\_\_\_\_/\_\_\_\_  
Address \_\_\_\_\_ Apt. \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
Since? (Mo./Yr.) \_\_\_\_\_ ☐ Buy ☐ Rent ☐ Other \_\_\_\_\_  
Previous Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
Employer \_\_\_\_\_ Since? (Mo./Yr.) \_\_\_\_\_  
Monthly Gross Salary \$ \_\_\_\_\_ Daytime Bus. Phone (\_\_\_\_\_) \_\_\_\_\_  
Previous Employer \_\_\_\_\_ From - To \_\_\_\_\_  
Occupation \_\_\_\_\_  
**Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying this obligation.**  
Additional Monthly Income \$ \_\_\_\_\_ Source: \_\_\_\_\_  
Name & Address of Nearest Relative Not Living With You \_\_\_\_\_  
Relationship \_\_\_\_\_

### B. CREDIT INFORMATION

PLEASE TELL US IF YOU HAVE: Checking Account ☐ Yes ☐ No  
Savings Account ☐ Yes ☐ No

|                      | Y/N   | How Many? | Y/N                      | How Many? |
|----------------------|-------|-----------|--------------------------|-----------|
| Bank Loan            | _____ | _____     | Dept. Store Charge Card  | _____     |
| VISA                 | _____ | _____     | Credit Union Account     | _____     |
| MasterCard           | _____ | _____     | Other Major Charge Cards | _____     |
| Finance Company Loan | _____ | _____     |                          |           |

### C. JOINT APPLICANT INFORMATION

Joint Applicant's Name \_\_\_\_\_  
Soc. Sec. No. \_\_\_\_\_ Date of Birth \_\_\_\_/\_\_\_\_/\_\_\_\_  
Address \_\_\_\_\_ Apt. \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
Home Phone (\_\_\_\_\_) \_\_\_\_\_ Date of Residence (Mo./Yr.) \_\_\_\_\_  
Joint Applicant's Employer \_\_\_\_\_ Since? (Mo./Yr.) \_\_\_\_\_  
Bus. Phone (\_\_\_\_\_) \_\_\_\_\_ Monthly Gross Salary \$ \_\_\_\_\_

### CUSTOMER AUTHORIZATION

I authorize ZEOS International, Ltd. or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct to the best of my knowledge and belief.

Applicant's Signature \_\_\_\_\_  
Date \_\_\_\_\_

Joint Applicant's Signature \_\_\_\_\_  
Date \_\_\_\_\_

**FOR MARRIED WISCONSIN APPLICANTS:**  
I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

Buyer's Signature \_\_\_\_\_ Date \_\_\_\_\_

There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 800-421-8942 or 612-635-0613 or write to ZEOS, Z•Card Processing Center, 530 5th Avenue N.W., St. Paul, MN 55112.

NY—A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

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\*Financing not available in Alaska, Hawaii or outside the continental U.S.



# When there's only one LaserJet® to go around...

It's a lesson you learned long ago — how to share with others. But unfortunately, no one ever informed you of the ways to share a LaserJet® printer.

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So now you've got several people in an office all vying for the rights to a single printer. What do you do? Learn to share with **Pacific Connect™**.

This printer sharing device for the HP LaserJet Series II, IID, III, and IIID is perfect for environments with several PCs and/or Macintoshes. Why spend money on multiple LaserJet or PostScript® printers when you can share one LaserJet with up to five PC and Macintosh users?

**Pacific Connect** slips conveniently into the optional I/O slot on a LaserJet printer. So it's easy to install and easy to use. No other LaserJet printer sharing device comes complete with all the cables, adapters and Macintosh support needed. Of course, PostScript operation requires Pacific Data Products' award-winning PostScript language emulation cartridge, **PacificPage™** and the additional printer memory needed for printing PostScript files.

As if each user were printing to his own printer, **Pacific Connect** eliminates the need for mechanical switch boxes or networking software. And print jobs are placed in the user-upgradeable buffer memory of 256k or 1.25 MB, and printed in the order that they are received.

For product information contact Pacific Data Products at 9125 Rehco Road, San Diego, CA 92121, USA, (619) 597-4602 FAX (619) 552-0889.



## MULTIMEDIA

### PCs and Upgrade Kits

puter can then send the MIDI messages out to a synthesizer for playback.

Unlike waveform audio, where actual sounds are digitized and played back, MIDI stores very small messages. These tiny messages trigger a synthesizer to play musical tones.

What do these tones sound like? Violins? Trumpets? Helicopters? The answer is governed by a 2-byte Program Change message to the synthesizer. This message can select one of 128 instrument voices supported by the synthesizer.

MIDI messages contain a 4-bit "channel" identifier, which lets a single MIDI cable carry messages that can trigger notes for a variety of simultaneous instrument voices. At any time, each channel can be associated with a different instrument voice and play notes on that instrument. One channel is often reserved for a percussion voice; for percussion, different Note On messages do not play distinct musical pitches but distinct percussion sounds.

At least in theory, a single MIDI cable can deliver messages for 16 different instruments—and as many simultaneous notes for each.

A PC meeting the minimum-standard MPC specification must contain an internal MIDI synthesizer that supports three simultaneous melodic voices with an overall six-note polyphony, and a percussion voice with two-note polyphony.

The MPC standard does not specify how the synthesizer generates musical tones. It could use sampled waveforms or a technique promulgated by Yamaha called frequency modulation (FM). In FM synthesis, two or more waveforms modulate each other's frequencies to produce complex tones. These waveforms are generally called operators, and the more operators, the better. A MIDI synthesizer that uses two operators, like the ones in the systems reviewed here, will not pro-

duce musical tones as interesting as those of a synthesizer using four operators.

The multimedia PC must have a MIDI In port that you can connect to an external MIDI controller, such as a keyboard. This allows a multimedia application to capture and store MIDI messages from this controller. The multimedia PC must also have a MIDI Out port that you can connect to an external MIDI synthesizer. Generally, external MIDI synthesizers sound better—and are more expensive—than the synthesizers found on MIDI boards.

The audio outputs of the CD-ROM, waveform, and MIDI hardware need to be mixed and fed to an amplifier or (more commonly) self-amplified speakers. The integrated multimedia PCs or upgrade kits will usually do this mixing for you, but you may need a mixing box if you're putting together a multimedia PC

from disparate, non-MPC-trademark components.

If you want to use your MPC system's audio board with DOS programs, you might want to look for compatibility with the AdLib Sound Card, which is a MIDI synthesizer board, or the Roland MPU-401. Many DOS programs include drivers for the Adlib Sound Card. The Roland MPU-401, into which you can plug a MIDI synthesizer or MIDI keyboard, is a standard.

#### WHAT? NO ENHANCED VIDEO?

The multimedia PC Level 1 specification does not require that PCs or upgrade kits ship with special video adapters. (For more information, see the sidebar "Why Multimedia PCs Don't Deliver the Complete Picture.")

Support for video devices is provided through the Media Control Interface (MCI) of Multimedia Extensions. The MCI is a generalized interface to control a variety of multimedia devices, including laserdisks and video overlay boards. Even if Multimedia Extensions does not contain any explicit advanced video support, you can add this support through MCI drivers.

Microsoft is currently working on the

Audio-Video Interleave (AVI) specification. The AVI allows for the capture and storage of NTSC video signals through a video frame-grabber board at 15 frames per second (half the standard video frame rate used in US broadcast TV), interleaved with waveform audio. The video images are stored in the normal Windows device-independent bitmap (DIB) format. Because the AVI uses only bitmaps and waveform audio, playing these files under Multimedia Windows requires no hardware beyond the standard multimedia PC.

While the AVI is a simple interim solution to integrating full-motion video into multimedia applications, it is hardly the last word. Emerging standards in digital video must obviously be integrated into future versions of Multimedia Extensions, and MPC-trademark PCs and upgrade kits must come equipped to support them.

Still, sound support is a good start. Once you hear your PC talk and play music, you will never quite be satisfied with anything less.

### UPGRADE KITS

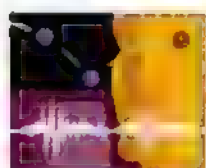
COMPUADD COMPUTER CORP.

#### CompuAdd Multimedia Upgrade Kit

**BY MITT JONES** Judging by the breadth of products CompuAdd Corp. has already begun shipping, the Austin, Texas-based company means to be a serious player in the multimedia market. Choice components from its 1991 holiday catalog include not only the \$1,069 CompuAdd Multimedia Upgrade Kit and the \$3,300 CompuAdd 320sc MPC 66405, which we also evaluated in this issue, but also two additional multimedia PCs—the \$2,395 CompuAdd 316s MPC and the \$4,495 CompuAdd 333 MPC—the \$299 CompuAdd AM/FM Tuner board, and the \$525 CompuAdd TV/Video Board, which lets you display television or video from other sources as well as capture and digitize individual frames.

The CompuAdd Multimedia Upgrade Kit we reviewed features the 380-millisecond Sony CDU-541—an internal drive that adheres to the Multimedia PC (MPC) specification 1.0—and CompuAdd's own Multimedia Sound Card, which doubles as an Adaptek-based SCSI host control-





# MULTIMEDIA

## PCs and Upgrade Kits



### SUMMARY OF FEATURES: MULTIMEDIA UPGRADE KITS AND PCs

Products listed in alphabetical order by category

☒—Yes ☐—No

List price (tested configuration)

Distribution channel

#### CD-ROM DRIVE

Mechanism manufacturer

Caddy manufacturer

Operates vertically

Audio support on drive:

Headphone jack

RCA jacks

Volume knob

#### CONTROLLER

Controller manufacturer

Interface type

IRQ levels supported

Number of selectable addresses

#### PERFORMANCE RATINGS

Average access time (milliseconds)

Data transfer rate (burst)

Percentage of CPU bandwidth consumed

Average latency:

Inner track (milliseconds)

Outer track (milliseconds)

Mean time between failures (hours)

Maximum number of daisy-chained  
CD-ROM units per PC

#### MIDI/WAVEFORM AUDIO CONTROLLER

Sound-card manufacturer

Model

Interface

IRQ levels supported

Number of selectable addresses

N/A—Not applicable: The product does not have this feature.  
KBps—kilobytes per second.

For this review, all the vendors of multimedia upgrade kits and PCs supplied us with internal half-height CD-ROM drives. These drives came equipped with a 64K look-ahead buffer and supported the transfer rate of 150K per second required by the MPC specification. Apart from the Tandy 2500 SX/20 Multimedia PC, which ships with separate sound and CD-ROM interface cards, all the multimedia upgrade kits and PCs supply the CD-ROM host controller on the sound card.

The products reviewed here rely on frequency modulation (FM) synthesis rather than the more sophisticated waveform synthesis. All of the sound cards use Yamaha MIDI synthesizers that include only two FM operators. Higher-end synthesizers use more operators and can produce more accurate musical tones. The MIDI controller on each board is a Yamaha YM3802. Each of the cards performs only 8-bit sampling for recording sound and reproducing audio files.

All the reviewed products let you control audio fade-in and fade-out, panning, left and right steering, and microphone mixing.

Some of the terms used in this table may need explanation:

**Distribution channel** Some machines or upgrade kits are sold directly through mail order or company-owned stores, others through dealers. *PC Magazine* views a 15 percent discount on PC systems sold through dealers as typical. Multimedia upgrade kits sold through dealers are also discounted by that much or a little more.

**Percentage of CPU bandwidth consumed** All CD-ROM drives subscribing to the MPC specification should be able to maintain the 150-KBps transfer rate without consuming more than 40 percent of the CPU bandwidth.

**Average latency** refers to the time between initiating a request for data and the start of the data transfer. On a CD-ROM disk, which is a rotating medium, latency refers to the time it takes for a selected sector to move into position under the read/write head.

**Amplifier (watts)** While some of these products claim ratings as high as 4 watts per channel, on our performance tests none of the units was capable of generating even 1 watt of power per channel with an 8-ohm load (the level used by a standard stereo speaker). It is possible that these systems can generate 4 watts per channel, but that will in most cases only be with a 4-ohm load or lower.

ler. Once you have installed the included Microsoft Windows with Multimedia Extensions 1.0 on your hard disk, you will find a couple of software treats: *Adobe Type Manager* and CompuAdd's elegant all-in-one multimedia utility, the *Rack Manager*. The kit also comes with MacroMind's *Action*—a multimedia presentation package—and is scheduled to begin shipping with a package of multimedia software from Voyetra as well.

The Voyetra package will include *MusiClips*, a collection of 150 MIDI songs and drum patterns; *Sequencer Plus Junior*, a DOS-based MIDI recorder, editor, and arranger; *WIN DAT*, which lets you record, edit, and play back MIDI files

from within Windows without using Multimedia Extensions; utilities that allow you to play audio files from the DOS prompt; and an applications interface, *Multimedia Player*, that lets developers add audio to software without using Voyetra's low-level commands.

#### ROUGH EDGES AND SOFTWARE SHORTCOMINGS

The first flaw we encountered came soon after unpacking the system. The multimedia board's documentation does a nice job of guiding you through installation of the board itself, but it directs you to a separate Sony pamphlet for instructions on installing the CD-ROM drive. Aside

from the brief software installation instructions in the multimedia board's manual, you will not find printed documentation for the CompuAdd-specific multimedia software, or even an explanation of what modules CompuAdd has provided. You will have to run the software and access CompuAdd's on-line help utilities—once you figure out how to do so—to learn how the pieces fit together.

The software provides the CompuAdd Upgrade Kit's most impressive asset—CompuAdd's *Rack Manager*—and some of its greatest failings. The *Rack Manager*, nicely designed to resemble a stack of home electronics components, is complete with simulated push buttons and





## MULTIMEDIA

### PCs and Upgrade Kits

| MULTIMEDIA UPGRADE KITS                                             |                                                                     |                                                                  | MULTIMEDIA PCs                                                      |                                                                     |
|---------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|
| CompuAdd Multimedia Upgrade Kit                                     | Creative Labs Multimedia Upgrade Kit                                | Media Vision Multimedia PC Upgrade Kit                           | CompuAdd 320sc MPC 66405                                            | Tandy 2500 SX/20 Multimedia PC                                      |
| \$1,069.00                                                          | \$849.95                                                            | \$995.00                                                         | \$3,300.00                                                          | \$4,946.90                                                          |
| Direct                                                              | Dealers, direct                                                     | Dealers                                                          | Direct                                                              | Direct                                                              |
| Sony<br>Sony<br>■<br>■<br>■<br>■                                    | Panasonic<br>Sony<br>■<br>■<br>■<br>■                               | Sony<br>Sony<br>■<br>■<br>■<br>■                                 | Sony<br>Sony<br>■<br>■<br>■<br>■                                    | Mitsumi<br>N/A<br>■<br>■<br>■<br>■                                  |
| Adaptec<br>SCSI<br>11, 12<br>None                                   | Creative Labs<br>Proprietary<br>2, 5, 7, 10<br>2                    | Adaptec<br>SCSI<br>3, 5, 6, 7<br>None                            | Adaptec<br>SCSI<br>11, 12<br>None                                   | Tandy<br>Proprietary<br>2, 3, 5<br>5                                |
| 380<br>187.5 KBps<br>22                                             | 390<br>250 KBps<br>35                                               | 380<br>187.5 KBps<br>36                                          | 380<br>187.5 KBps<br>22                                             | 800<br>175 KBps<br>35                                               |
| 55                                                                  | 60                                                                  | 55                                                               | 55                                                                  | Info not available                                                  |
| 130                                                                 | 140                                                                 | 130                                                              | 130                                                                 | Info not available                                                  |
| 10,000<br>7                                                         | 25,000<br>N/A                                                       | 10,000<br>8                                                      | 10,000<br>7                                                         | 10,000<br>N/A                                                       |
| CompuAdd<br>Multimedia<br>Sound Card<br>16-bit<br>5, 9, 10, 15<br>2 | Creative Labs<br>Sound Blaster<br>Pro<br>16-bit<br>2, 5, 7, 10<br>2 | Media Vision<br>Pro<br>AudioSpectrum<br>8-bit<br>3, 5, 6, 7<br>2 | CompuAdd<br>Multimedia<br>Sound Card<br>16-bit<br>5, 9, 10, 15<br>2 | Creative Labs<br>Sound Blaster<br>Pro<br>16-bit<br>2, 5, 7, 10<br>2 |

CONTINUES

LED indicators and provides access to kit functions from one screen.

On the downside, *Rack Manager* fails to provide a mixer for controlling the volume levels for the various supported devices—a feature that the Media Vision Multimedia PC Upgrade Kit handled nicely—and suffers from its own non-standard Windows implementation.

Each time you open Windows, you will be greeted with a custom CompuAdd screen instead of a Windows screen. This CompuAdd screen includes oversized and illustrated buttons for entry into the *Rack Manager*, a tour through the upgrade kit's capabilities, on-line help for the upgrade kit and Windows itself. It is attractive and

may be appealing to novices but becomes frustrating rather quickly. The only way to exit from the screen to DOS is to enter Windows proper by clicking on the appropriate button, then exit from Windows. If you want to enter Windows at the very beginning, you will have to wait for the CompuAdd system screen to appear first before waiting after a mouse click or two for Windows to come up.

#### AUDIO QUIRKS

The multimedia board comes with its own odd mix of assets and liabilities. Its scores on the sonic portion of PC Magazine Labs' tests were mostly midrange or slightly below (especially on the Frequency Re-



#### CompuAdd Multimedia Upgrade Kit

CompuAdd Computer Corp., 12303 Technology Blvd., Austin, TX 78727; 800-627-1967.

List Price: \$1,069; external version, \$1,295.

Requires: 10-MHz 80286 PC or better, 2MB RAM, 30MB hard disk, VGA monitor and adapter or better.

**In Short:** Attractive utility software and an audio board that simultaneously accommodates seven different input sources (including the CompuAdd TV/Video board and the AM/FM Tuner board) somewhat make up for a few noticeable deficiencies. These include the lack of more than one synthesizer chip, the inability to generate stereo signals, and a joystick port that requires its own expansion slot. On top of that, the CompuAdd Multimedia Upgrade Kit's price—the highest of all the upgrade kits reviewed here—is better suited for a system that provides more than midlevel waveform audio performance.

CIRCLE 476 ON READER SERVICE CARD

sponse test). Unlike the Media Vision Upgrade Kit's board, the CompuAdd offering accommodates jacks for up to seven different input sources at once, including the CompuAdd TV/Video board and CompuAdd AM/FM Tuner board; it also comes with stereo line-out and amplified speaker-out jacks. Unfortunately, and also unlike the Media Vision Upgrade Kit, CompuAdd's offering employs only one Yamaha YM3812 synthesizer, which means it cannot produce stereo audio. The board can pass-through stereo signals and play stereo CD-audio from the CD-ROM drive, but it cannot generate stereo signals itself. The board carries one 8-bit DAC and one 8-bit ADC and will sample from 4 kHz to 50 kHz, but without hardware compression.

As you would for the Media Vision Upgrade Kit, you will have to buy an optional cable (\$14.95) if you want to hook a device to the MIDI connector. If you need a joystick port, you will also have to install a second 8-bit card, which CompuAdd ships with its line of upgrade kits. The card supports two IBM-compatible joysticks.





## SUMMARY OF FEATURES: MULTIMEDIA UPGRADE KITS AND PCs

|                                                                                               | MULTIMEDIA UPGRADE KITS               |                                            |                                              | MULTIMEDIA PCs                      |                                      |
|-----------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------|----------------------------------------------|-------------------------------------|--------------------------------------|
|                                                                                               | CompuAdd<br>Multimedia<br>Upgrade Kit | Creative Labs<br>Multimedia<br>Upgrade Kit | Media Vision<br>Multimedia PC<br>Upgrade Kit | CompuAdd<br>320sc MPC 66405         | Tandy<br>2500 SX/20<br>Multimedia PC |
| <div> <input checked="" type="checkbox"/> —Yes    <input type="checkbox"/> —No         </div> |                                       |                                            |                                              |                                     |                                      |
| <b>COMPATIBILITY</b>                                                                          |                                       |                                            |                                              |                                     |                                      |
| AdLib Sound Card                                                                              | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>  |
| Roland MPU-401                                                                                | <input type="checkbox"/>              | <input type="checkbox"/>                   | <input type="checkbox"/>                     | <input type="checkbox"/>            | <input type="checkbox"/>             |
| <b>INSTRUMENT VOICE SUPPORT</b>                                                               |                                       |                                            |                                              |                                     |                                      |
| Maximum number of simultaneous instrument voices                                              | 11                                    | 22                                         | 22                                           | 11                                  | 22                                   |
| Maximum number of simultaneous percussion voices                                              | 5                                     | 10                                         | 10                                           | 5                                   | 10                                   |
| Maximum number of simultaneous melodic voices                                                 | 9                                     | 12                                         | 18                                           | 9                                   | 12                                   |
| Maximum number of simultaneous notes                                                          | 9                                     | 22                                         | 22                                           | 9                                   | 22                                   |
| Voice input and output                                                                        | Mono                                  | Stereo                                     | Stereo                                       | Mono                                | Stereo                               |
| <b>VOLUME CONTROL</b>                                                                         |                                       |                                            |                                              |                                     |                                      |
| Programmable master volume control                                                            | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>  |
| Individual-device volume control                                                              | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>  |
| Manual volume control on-board                                                                | <input type="checkbox"/>              | <input checked="" type="checkbox"/>        | <input type="checkbox"/>                     | <input type="checkbox"/>            | <input checked="" type="checkbox"/>  |
| <b>MIXING CAPABILITIES</b>                                                                    |                                       |                                            |                                              |                                     |                                      |
| Mixes audio sources from:                                                                     |                                       |                                            |                                              |                                     |                                      |
| CD-audio                                                                                      | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>  |
| Microphone                                                                                    | <input type="checkbox"/>              | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input type="checkbox"/>            | <input checked="" type="checkbox"/>  |
| PC internal speaker                                                                           | <input type="checkbox"/>              | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input type="checkbox"/>            | <input checked="" type="checkbox"/>  |
| Stereo DAC                                                                                    | <input type="checkbox"/>              | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input type="checkbox"/>            | <input checked="" type="checkbox"/>  |
| Stereo FM                                                                                     | <input type="checkbox"/>              | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input type="checkbox"/>            | <input checked="" type="checkbox"/>  |
| Stereo line in                                                                                | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>  |
| Number of channels (recording mixer)                                                          | 6                                     | 3                                          | 5                                            | 6                                   | 3                                    |
| Number of channels (playback mixer)                                                           | 7                                     | 5                                          | 5                                            | 7                                   | 5                                    |
| Number of volume settings per channel                                                         | 13                                    | 16                                         | 31                                           | 13                                  | 16                                   |
| <b>AMPLIFICATION</b>                                                                          |                                       |                                            |                                              |                                     |                                      |
| Power amplifier stage                                                                         | <input checked="" type="checkbox"/>   | <input checked="" type="checkbox"/>        | <input type="checkbox"/>                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>  |
| Amplifier (watts)                                                                             | 2 per channel                         | 4 per channel                              | 2 per channel                                | 2 per channel                       | 4 per channel                        |

N/A—Not applicable: The product does not have this feature.

ENDS

Like its peers, the CD-ROM drive included with the CompuAdd Upgrade Kit measured up to the specification of 150 kilobytes per second on our CD-ROM performance tests. The video motion looked good; we didn't notice any stops in the action.

The several niceties of the CompuAdd Upgrade Kit, like the *Rack Manager* and the upcoming *Voyetra* software, make it a promising multimedia offering. CompuAdd also provides a one-year parts-and-labor warranty with its products, as well as toll-free technical support at no cost. But its price—the highest of the three multimedia upgrade kits—and its single frequency modulation (FM) synthesizer chip are notable drawbacks. You will also have to take up an extra slot for the joystick port—something the other upgrade kits include on the audio card. It may be

worthwhile to investigate the options from other vendors or wait for the next version of the Compuadd Multimedia Upgrade Kit.

## CREATIVE LABS INC.

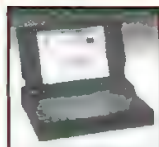
## Creative Labs Multimedia Upgrade Kit

**BY JOHN R. QUAIN** In 1986, Creative Labs introduced the Game Blaster for those PC users who wanted to add sonic pyrotechnics capabilities to their after-hours gaming activities. To address today's multimedia music, voice, MIDI, and CD-ROM requirements, Creative

Labs is offering increased audio capabilities in the Sound Blaster Pro board that it includes in its \$849.95 Creative Labs Multimedia Upgrade Kit.

With a modest street price of \$700, the Creative Labs Upgrade Kit is made up of the 16-bit Sound Blaster Pro ISA audio card (though it provides only 8-bit access), an internal 390-millisecond Matsushita (Panasonic) CR-251 CD-ROM drive, and *Voyetra's Sequencer Plus Junior*. Like all the products in this roundup, the Creative Labs Upgrade Kit performs only 8-bit sampling (versus CD-quality 16-bit sound), but it comes bundled with several entertaining DOS programs, including updated versions of Sound Blaster's *Dr. Sbaitso2*, *Talking Parrot*, and *FM Intelligent Organ*. Additional software bundled with the package includes the game *Jones in the Fast Lane*, Microsoft Windows





## Metalis SX/16 Notebook PC

✓ 80C386SX Microprocessor, 16/8 MHz ✓ 1 MB RAM, Exp. to 2, Or 5 MB On Main Board ✓ 3.5" 1.44 MB  
✓ 40 MB With Access Time Of 29ms  
✓ LCD Screen: B&W With 32-Gray Scale ✓ Keyboard Selectable Normal/  
Reverse Video Mode ✓ 80 Key Keyboard  
✓ Password Protection, Extended/Expanded Memory, Shadow  
RAM, Power Management Options ✓ System Also Includes:  
2400 Baud Int. Fax/Modem, Mouse Pen, User's Manual, MS  
DOS, Custom Slip-Cover Carry Case, GeoWorks Ensemble  
✓ One Year Parts And Labor Warranty

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## MAGNAVOX 386SX/16 Personal Computer

✓ 386SX CPU ✓ 16/8 MHz Speed ✓ 1 MB RAM Snd., Exp. to 8 MB  
✓ Three 16-Bit Expansion Slots ✓ 101-Key Keyboard ✓ 1.44 MB 3.5"  
Floppy ✓ 12 MB 5.25" Floppy ✓ 40 MB Hard Drive ✓ Super VGA  
Adapter (800 x 600), VGA, EGA, CGA ✓ 2 Serial, 1 Parallel ✓ Novell  
Workstation Approved ✓ MS-DOS, MS-DOS Shell, GW-BASIC  
✓ LotusWorks (Integrated Software - Word  
Processor, Spreadsheet, Database, Graphics,  
Communications, Spell Checker, Thesaurus)  
✓ 1-Year Parts and Labor Warranty



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**\$729.25** 20094

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## MAGNAVOX 386SX/20 DESKTOP



✓ 80386SX Processor ✓ 20/8 MHz  
✓ 2 MB RAM, (8 Max.) ✓ 80 MB HD  
✓ (4) 16-Bit Expansion Slots  
✓ (5) 4-External, 1-Internal Drive Bays  
✓ 101-Key Keyboard ✓ One 3.5" (1.44  
MB) ✓ One 5.25" (1.2 MB) ✓ Super VGA  
(800 x 600), VGA, EGA, CGA ✓ Parallel  
Port, 2 Serial Ports ✓ 3-Button Serial Mouse  
✓ Operating System: MS-DOS® 5.0, Q-Basic ✓ Microsoft Windows  
3.0 ✓ Novell Workstation and Server Approved. Windows 3.0  
Certified ✓ Includes: Word Processor, Paint Program,



Communications Program, Calendar Planner, Calculator, Clock Program, Cardfile and  
Notepad, Macro Recorder, Two Games ✓ 1 Year Parts/Labor (1 Year On-Site Service)

CDW® Price ..... **\$989.50** 21561

**MAGNAVOX 386SX/20 CD Model** (1 Year Warranty, 6 Months On-Site)  
✓ Includes: Grolier Electronic Encyclopedia, Microsoft Bookshelf, Microsoft Small  
Business Consultant, Microsoft Stat Pack CD Roms

CDW® Price ..... **\$1329.25** 19833

**Selected As PC Magazine's Editor's Choice**

## MAGNAVOX 386/33 DESKTOP

✓ 386DX CPU ✓ 33/8 MHz Speed ✓ 2 MB RAM Standard, Expansion to  
64 MB ✓ Six 16-Bit Expansion Slots ✓ On-Board Clock/Calendar  
✓ 101-Key Keyboard ✓ AT-IDE Hard Disk and Floppy Controller Built-In  
✓ 1.44 MB High Density 3.5" Floppy Disk ✓ 1.2 MB 5.25" Floppy Disk  
✓ 120 MB Hard Drive ✓ Analog Output Which Supports Extended VGA,  
Super VGA, VGA, EGA, MCGA, CGA, MDA, Hercules (1024 x 768 x 16)  
✓ 512 K Video RAM ✓ 2 Serial, 1 Parallel, 1 Video Ports ✓ Novell  
Workstation and Server Approved Windows 3.0 Certified. SCO Certified (for  
UNIX and ODT) ✓ Operating System Software: MS-DOS, MS-DOS Shell,  
GW-BASIC, LIM EMS 4.0 Drivers  
✓ Bundled Disk Software: Geoworks Ensemble  
(Integrated Software) - GeoManager, GeoWrite,  
GeoDraw, GeoPlanner, Geodex, GeoComm,  
America Online, Banner, Solitaire, Lotus 1-2-3  
v2.2 Mouse  
✓ 1-Year Parts and Labor Warranty  
✓ 6 Month On-Site



CDW® Price **\$1399.60** 19834

**MAGNAVOX**

## MAGNAVOX Metalis/SX20 Notebook PC

✓ 80C386SX Microprocessor, 20/10 MHz ✓ 2 MB RAM, Expandable to 8MB  
✓ Clock/Calendar LED Indicators 3.5, 1.44MB Floppy ✓ 2.5 60MB HD  
With Access Time of 19ms; Auto-Park Feature ✓ Full Travel 80-Key Keyboard  
With 12 Function Keys and Imbedded Numeric Keypad; Emulates 101/102 Key  
Enhanced Keyboard ✓ B&W With 32 Gray Scale, CCFT Side-Lit, VGA 640 x  
480 Resolution, .27mm Dot Pitch ✓ Input/Output Ports ✓ Power Management  
Features ✓ Battery-Rechargeable ✓ One Year Parts and Labor Warranty



## MAGNAVOX

UP TO 5 HOURS BATTERY LIFE!

CDW® Price... **\$1797.75** 20955



## Metalis 286

✓ 80C286 Microprocessor, 12/6 MHz  
✓ 1 MB, Expandable to 2, 5, or 8 MB  
✓ Clock/Calendar ✓ LED Indicators  
✓ 3.5", 1.44 MB ✓ 2.5" 20 MB With  
Access Time of 23ms ✓ B&W With 32-  
Gray Scale, CCFT Side-Lit ✓ VGA 640  
x 480 Resolution; 0.27mm Dot Pitch  
✓ Input/Output Ports ✓ Full Travel  
(3.5mm) 79/80-Key With 12 Function  
Keys and Imbedded Numeric Keypad;  
Emulates 101/102-Key Enhanced  
Keyboard ✓ Power Management  
Features ✓ Battery-Rechargeable ✓ One Year Parts and Labor

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CDW® Price ..... **\$899.00** 19391

MAGNAVOX Monochrome 640 x 480 VGA Monitor ..... **\$119.65** 17756  
MAGNAVOX Color 640 x 480 VGA .39mm Monitor ..... **\$229.20** 21563  
MAGNAVOX Color 1024 x 768 Super VGA .39mm Monitor ..... **\$259.24** 21566  
MAGNAVOX Color 1024 x 768 Super VGA .28mm Monitor ..... **\$329.00** 19224

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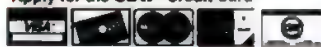
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## SUMMARY OF FEATURES: MULTIMEDIA PCs

Products listed in alphabetical order

**When considering these computers, you should not choose one for its multimedia merits alone. Keep in mind that you will be using it for other tasks, and it should be able to perform a broad range of functions.**

**List price (PC Magazine configuration)**

For this review of 20-MHz 386SX-based multimedia PCs, we requested a configuration that included at least 4MB of RAM; a 100MB hard disk (or whatever the company offered closest to it); one 3.5-inch floppy disk drive; a VGA color display subsystem or better; parallel, serial, joystick, and MIDI I/O ports; a CD-ROM drive; MIDI and waveform audio support; DOS 5.0; Microsoft Windows with Multimedia Extensions 1.0; and a two-button mouse. Both of the reviewed PCs provide a reasonably close match to this list of requirements.

**Chip set manufacturer** indicates which company makes the logic that connects the CPU with the other functions managed by the system board. Chip sets that use VLSI (very large-scale integration) technology reduce the discrete component count, which in turn helps reduce power consumption and increases component life.

**System shadowing/Video shadowing** Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up, offering enhanced performance speed. Shadowing uses RAM located between 640K and 1MB.

**The BIOS version** can affect PC Magazine Labs' benchmark test results. Those purchasing the same-model machine with a different BIOS version may encounter some variations in performance.

**Installable RAM** indicates the maximum amount of memory that can be installed on the motherboard. In the case of the Tandy

2500 SX/20 Multimedia PC, only one 16-bit expansion slot is free for adding more memory to the system; the CompuAdd 320sc MPC 66405 sports three free 16-bit slots.

**Front-accessible drive bays** can support removable media (such as tape and CD-ROMs); **internal drive bays** can be reached only by opening the case. We report the maximum number of accessible and internal drives the system can hold.

**Hard disk options** We report the hard disk capacities the vendor offers.

**Disk controller location** A computer with IDE (integrated drive electronics) circuitry has its controller functions integrated into the drive and motherboard.

**Expansion bus** For each type of expansion slot—8-bit and 16-bit—we report the number of slots on the motherboard and the number of slots left open when the unit is equipped in our PC Magazine configuration.

**Tested display mode** refers to the resolution of the video card that came in the tested configuration.

**The display circuitry** can reside on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled there is no way to upgrade it.

**Number of device connectors** indicates how many internal storage devices the power supply can support without requiring Y cables (power splitters).

■—Yes □—No

List price (PC Magazine configuration)

Hard disk capacity

Case type

Cabinet measurements (HWD, in inches)

Bus architecture

Setup/password in ROM

**MOTHERBOARD**

Motherboard manufacturer

Chip set manufacturer

Chip set uses VLSI technology

System shadowing/Video shadowing

BIOS version

Supports Weitek coprocessor

**MEMORY AND PROCESSOR RAM CACHE**

System RAM arrangement

Installable RAM

Installable RAM cache

**DISK DRIVES**

Front-accessible drive bays

Internal drive bays

Hard disk options

Disk controller location

**EXPANSION BUS**

8-bit

16-bit

Parallel, serial, mouse ports on motherboard

**VIDEO**

Tested display mode

Display circuitry location

User can disable video circuitry

Interface

Video chip set manufacturer

**MISCELLANEOUS**

Power supply (watts)

Number of device connectors

with Multimedia Extensions 1.0, and *Microsoft Bookshelf for Windows*.

**WHAT'S INSIDE**

Rated at 4 watts per channel, the Sound Blaster Pro is an update of the company's two-year-old monaural Sound Blaster. Compatible with software written for the earlier model, the "Pro" signifies stereo sound and an integrated proprietary CD-ROM controller. The accompanying half-height Matsushita drive includes a Sony-compatible caddy, a minijack for

headphones, and an eject button.

On the Sound Blaster Pro, single mini-RCA-style jacks handle microphone input, stereo line-level input, and speaker output (4 ohms). A dial on the back of the card controls the manual volume. A MIDI/joystick adapter cable is included so that you can connect both to the card's mini 15-pin D-sub connector.

FM MIDI synthesis is handled by twin FM chips, each of which can manage nine instruments and five rhythm sounds. The accompanying DOS-based Voyetra Se-

quencer enables users to store and edit standard MIDI files, as well as Roland SoundClips. Like the other kits, including the Tandy system (which also includes the Sound Blaster Pro), the board's FM synthesis uses only two operators (or waveforms).

For converting analog sounds into digital files, the Sound Blaster Pro uses two 8-bit analog-to-digital converters (ADCs). Software compression allows users to select sampling rates from 4 kHz to 44.1 kHz and compress files by as much





# MULTIMEDIA

## PCs and Upgrade Kits



### Creative Labs Multimedia Upgrade Kit

Creative Labs Inc., 2050 Duane Ave., Santa Clara, CA 95054; 408-986-1461.

List Price: \$849.95.

Requires: 10-MHz 80286 PC or better, 2MB RAM, 30MB hard disk, VGA monitor and adapter or better.

**In Short:** This upgrade kit offers some strikingly good waveform audio performance, but the rest of its abilities is unfortunately not as praiseworthy. Feature-wise, it competes favorably with the Media Vision Multimedia PC Upgrade Kit, but it cannot provide similar consistent and good performance. Another advantage is its price—the lowest of any multimedia upgrade kit we reviewed.

CIRCLE 477 ON READER SERVICE CARD

about 40 minutes. The software is helpful, and supplied diagnostics determine the correct DMA channel (0, 1, or 3), hardware interrupt (2, 5, 7, or 10), and I/O address (220 or 240) settings. The only annoyance is that the MSCDEX driver is not automatically loaded into the AUTOEXEC.BAT file (to avoid network conflicts). You must manually insert the directory into the path statement and add a command line in order for the drive to be recognized.

### HOW IT STOOD UP

Once properly configured, the Matsushita CD-ROM drive proved able enough. On PC Magazine Labs' CD-ROM performance tests, the drive met or slightly exceeded the 150 kilobyte-per-second throughput requirement of the MPC standard on the 2MB- and 10MB-file tests. In terms of hands-on tests, its CD-ROM motion video was unimpeded. We experienced none of the system hangs and pauses that sometimes occurs when drives have inadequate throughput.

The Sound Blaster Pro performed well on certain sonic tests but not across the board. On the Frequency Response test, for example, the card's response was down 9 dB at 20 kHz versus the Media Vision

Upgrade Kit board's mere 4-dB drop; consequently, the Sound Blaster Pro's frequency loss in treble passages was more noticeable. While performance on the Total Harmonic Distortion (Amplifier) test was the best for this group, its Total Harmonic Distortion (Line) test result was 0.46 percent (compared with the Media Vision Upgrade Kit's 0.14 percent). The board did well on the Signal-to-Noise Ratio tests.

For creating multimedia presentations, the Creative Labs Upgrade Kit includes its *Voice Editor II* for editing waveform voice data, a rudimentary text-to-speech synthesizer, and the company's *MMplay*. The last is a script-based DOS application for creating sound and graphic presentations. It requires the user to create files and enter line-by-line commands. It is therefore time-consuming and lacks the sophistication—and documentation—to do extensive multimedia presentations.

For Multimedia Windows users, in addition to the standard *Music Box*, *Media Player*, *Mixer*, and *Sound Recorder* utilities, Creative Labs includes *Chatterbox* and *Jukebox*. *Chatterbox* enables you to select .WAV audio files and queue them to play in any sequence. Doing so, however, will leave pauses between selections. *Jukebox* performs identical functions using standard MIDI files and allows you to sing along by using an optional microphone.

The kit is covered by a one-year parts-and-labor warranty and enjoys plenty of third-party support, but the free technical support is a toll call.

With nearly equivalent features but generally inferior audio performance than the Media Vision Multimedia PC Upgrade Kit, it is difficult to recommend the Creative Labs Multimedia Upgrade Kit. If the price difference is important to you, though, this package will suffice.

### MEDIA VISION INC.

## Media Vision Multimedia PC Upgrade Kit

**BY MITT JONES** Those who want the best sound possible out of their multimedia PC upgrade kits should remember this name: Media Vision. The kit reviewed here, the \$995 Media Vision Multimedia

### CompuAdd 320sc Multimedia PC 66405

\$3,300.00

120MB

Slimline  
4.5 x 19 x 17  
ISA  
□/□

### Tandy 2500 SX/20 Multimedia PC

\$4,946.90

105MB

Slimline  
4.5 x 15.5 x 15  
ISA  
■/■

### CompuAdd

Texas Instruments

■

■/■

Phoenix 1.10.00

■

### Tandy

Headland

■

■/■

Phoenix 1.10.01

■

Interleaved page

32MB

64K

Interleaved page

5MB

None

Two 5.25-inch,  
no 3.5-inch

Two 3.5-inch  
80MB, 120MB,  
200MB

Integrated

One 5.25-inch,  
one 3.5-inch

One 3.5-inch  
52MB, 105MB,  
200MB, 440MB

Integrated

1 (open)

4 (3 open)

■

None

3 (1 open)

■

1,024 x 768

Motherboard

■

16-bit

Tseng

1,024 x 768

Motherboard

■

16-bit

Western Digital

200

4

70

2

as 4 to 1. But most users probably won't want to sample sounds at lower rates, given the deterioration in sound quality.

Stereo output is delivered via dual 8-bit digital-to-analog converters (DACs). Like the other multimedia upgrade kits and PCs we looked at, both the DACs and ADCs have maximum sampling rates of only 22.05 kHz in stereo (44.1 kHz in mono), thus limiting the recording fidelity.

Installing the Creative Labs Upgrade Kit's hardware and software will take





## CD-ROM PERFORMANCE TESTS

On our tests, the CD-ROM drives that came with the MPC-trademark PCs and upgrade kits all measured up to the MPC standard, which specifies a continuous transfer rate of 150 kilobytes per second.

## HOW WE TESTED

For the MPC upgrade kits, PC Magazine Labs performed Sequential Throughput performance tests on a Micro Express 386SX/20 (a previous Editors' Choice) equipped with 4MB of RAM.

The CD-ROM drives found in the CompuAdd 320sc MPC 66405 and the Tandy 2500 SX/20 Multimedia PC were tested on those machines. The CompuAdd 320sc was equipped with 4MB of RAM for our Sequential Throughput tests. The Tandy 2500 SX/20 included 5MB of RAM. These two PCs read a 2MB file and a 10MB file from the CD-ROM in 16-kilobit blocks, the minimum requirement for MPC compliance. Our tests access the MSCDEX driver

through DOS and therefore represent the worst possible case, since most applications programs should access the driver directly. A 2 to 3 percent variation in the test results, as compared with the MPC standard, is not unexpected; such a variation does not mean the drive fails to meet that standard.

For comparison, we also looked at non-MPC-trademark CD-ROM drives—the NEC Intersect CDR-73M, the Sony CDU-7205, and the Toshiba TXM-3301E—which are not part of any MPC PCs or upgrade kits. We also tested these three standalone drives on a Micro Express 386SX/20 with 4MB of RAM.

SEQUENTIAL THROUGHPUT  
(kilobytes per second)

## 2MB File

## 10MB File

|                                        |     |     |
|----------------------------------------|-----|-----|
| * NEC Intersect CDR-73M                | 205 | 211 |
| CompuAdd 320sc MPC 66405               | 151 | 150 |
| Creative Labs Multimedia Upgrade Kit   | 151 | 151 |
| Media Vision Multimedia PC Upgrade Kit | 151 | 150 |
| * Sony CDU-7205                        | 151 | 151 |
| * Toshiba TXM-3301E                    | 151 | 151 |
| CompuAdd Multimedia Upgrade Kit        | 149 | 150 |
| Tandy 2500 SX/20 Multimedia PC         | 148 | 146 |

\* Reported for comparison.

## WHAT THE NUMBERS MEAN

All the CD-ROM drives that came as part of a multimedia PC or upgrade kit performed well on our tests, which indicates that these drives all conform to the 150-KBps standard. Some slightly exceeded this number (like the Creative Labs Multimedia Upgrade Kit, which uses the Matsushita [Panasonic] CR-251 CD-ROM). Others, like the Tandy 2500 SX/20 Multimedia PC, fell slightly short of that standard (this unit uses Tandy's own CDR-1000 drive, which is actually manufactured by Mitsumi). Their scores still fell well within the 2 to 3 percent variation range.

Not surprisingly, the CompuAdd 320sc MPC 66405, the CompuAdd Multimedia Upgrade Kit, and the Media Vision Multimedia PC Upgrade Kit had identical or almost identical scores. These systems all use the Sony CDU-541 CD-ROM drive.

Among the non-MPC-trademark CD-ROM drives we tested for comparison, the NEC Intersect CDR-73M returned an extremely high throughput score, largely because it uses a nonstandardized technique that lets the CD spin faster. The Sony CDU-7205 and the Toshiba TXM-3301E both turned in throughput scores that meet the MPC specification.

The **Sequential Throughput** is calculated by measuring the average time required to read 16-kilobit blocks from a 2MB file and a 10MB file. The sequential throughput reflects the drive's performance during such operations as loading programs and large data files.

PC Upgrade Kit, comes significantly closer than its competitors to high-fidelity audio CD.

Based on Media Vision's Pro Audio-Spectrum multifunction audio board and the 380-millisecond Sony CDU-541 internal drive, the Media Vision Upgrade Kit occupies one 8-bit slot and comes with Compton's *Multimedia Encyclopedia*, Sierra On-Line's *Jones in the Fast Lane*, and a third CD-ROM disk that provides Microsoft Windows with Multimedia Extensions 1.0 and a selection of audio samplers. Media Vision backs the product with a one-year warranty on parts and labor and generous free customer support via a toll-free number and a 24-hour BBS.

As one would expect, the Sony CDU-541—the same drive used by CompuAdd in its \$1,069 CompuAdd Multimedia Upgrade Kit—conforms nicely to the Multimedia (MPC) specification, supporting a sustained transfer rate of 150 kilobytes per second and employing a 64K

cache. The drive provides a headphone jack and volume control on the front panel, and it of course uses the Sony disk caddy.

The three-quarter-length Pro Audio-Spectrum board supplies the Adaptec SCSI controller, which can accommodate as many as seven additional SCSI devices. The board's audio components feature a Yamaha YM3802 MIDI controller and two 11-voice Yamaha YM3812 synthesizers—one per channel. Slot-bracket connectors include stereo line-in, stereo line-out, microphone-in, and a dual-purpose joystick/MIDI connector. There is one 8-bit DAC, and the board samples from 2 kHz to 44 kHz without hardware compression.

## INSTALLATION UPS AND DOWNS

Installing the upgrade kit should present no insurmountable challenges, but Media Vision has done a mixed job of packaging the kit as a whole. The installation documentation is superb for the most part,

including a brief pamphlet that introduces and explains the kit and another that steps buyers through the straightforward process of installing the hardware, Media Vision utilities, and Multimedia Windows. While novices are directed to install the board at its default settings, more experienced users will find guidance on altering the default DMA and IRQ settings.

On the other hand, Media Vision failed to provide drive rails with our unit (the company doesn't plan to include them in the future, either), and the installation instructions for Compton's *Multimedia Encyclopedia* CD were erroneous. Neither problem is terribly serious, and the company is planning to fix the installation instructions, but the current rough edges will make life a bit difficult for novices and detract from an offering that is otherwise well-thought-out.

The Media Vision Upgrade Kit is not designed for hooking up speakers that aren't self-amplified to the line-out con-

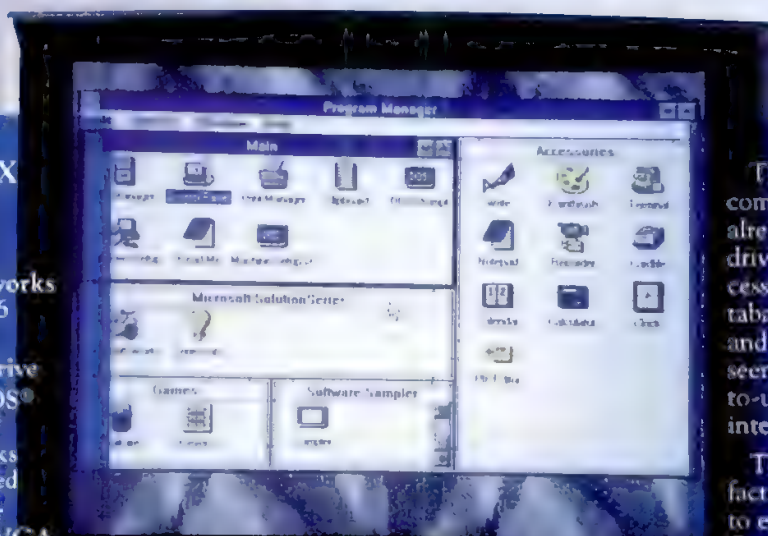


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# Special Edition!

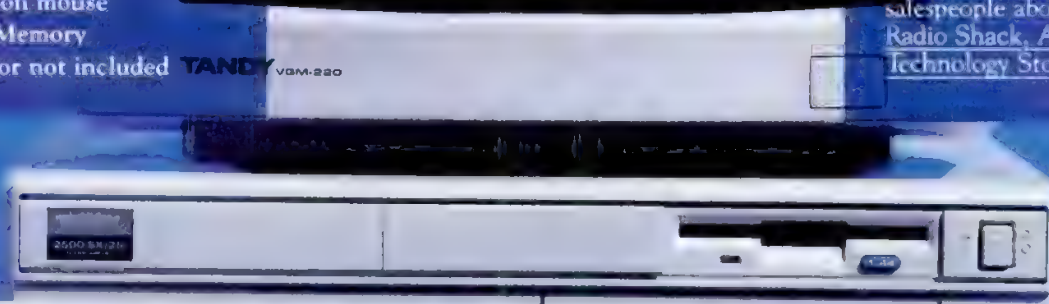
Get an Am386™ SX  
Home Office PC  
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- 25 MHz processor works 50% faster than a 16 MHz 386SX
- 85-megabyte hard drive
- Comes with MS-DOS® 5.0, plus Microsoft® Windows® and Works for Windows installed
- Super VGA for four times the clarity of VGA
- 2-button mouse
- 2MB Memory
- Monitor not included



The Tandy 2500 SX/25 comes with Microsoft Works® already installed on the hard drive, combining word processing, business analysis, database management, charting and illustration. And Works seems like play with the easy-to-use graphical Windows interface.

The 2500 SX/25 is manufactured in our U.S. factories to exacting specifications. Come ask our knowledgeable salespeople about it today at Radio Shack, America's Technology Store.



# TANDY



## AUDIO PERFORMANCE TESTS

**None of the multimedia upgrade kits or PCs provide the quality audio capability you would expect from a high-fidelity CD player or stereo amplifier. In many respects, the Pro Audio-Spectrum board included with the Media Vision Multimedia PC Upgrade Kit comes closest to high-fidelity sound.**

### WHAT THE NUMBERS MEAN

None of the multimedia PCs or upgrade kits met the standards for frequency response, distortion, and signal-to-noise ratio that one would associate with high-fidelity stereo amplifiers and CD players. High-fidelity units have a flatter frequency response, for example, in the range of  $\pm 0.5$  dB. Their total harmonic distortion figures would have been lower than 0.01 percent, and their signal-to-noise ratios greater than 90 dB.

The dynamic range of each multimedia machine's CD portion was even more restricted than our Signal-to-Noise Ratio measurements (Line and Amplifier) would suggest. When we measure the 0-Hz signal to determine the amount of background noise, the audio board's digital-to-analog converter (DAC) is not being exercised; only the noise of the analog electronics is registered. Each unit's DAC was 8-bit, as opposed to the 16-bit converters generally used by audio CD players. This means that the music's loud-to-soft range must be expressed in only 256 steps ( $2^8$ ) rather than the normal 65,536 steps ( $2^{16}$ ). In more conventional audio terms, the dynamic range of an 8-bit multimedia source is 48 dB; a 16-bit source has a dynamic range of 96 dB. (The dynamic range is the difference between the largest and smallest signal levels a system can handle.) This 8-bit restriction lent a somewhat compressed sound quality to the conventional CDs each multimedia unit's CD-ROM facility played.

All the products suffered from inadequate computer power-supply filtering, which produced a low-frequency hum through our wide-range speakers at all listening levels. This is not surpris-

ing, as computer power supplies have not previously been required to employ the lower residual hum components necessary for powering audio devices.

For adding sound to visually oriented presentations or adding sound effects to games, however, strict high-fidelity standards may be unnecessary. Of the units we reviewed, the Media Vision Upgrade Kit boasted some of the top audio performance, besting its peers on the Frequency Response, Sensitivity (Line Input), and Total Harmonic Distortion (Line) tests. It also provided the best Tone Control Range performance, and fell in the middle of the pack on the Volume-Control Resolution test.

The Media Vision Upgrade Kit's board showed extraordinary sensitivity at its line-input jack—which was probably responsible for its low Signal-to-Noise Ratio (Line) test score. Although this audio board lacks on-board power amplifiers (which the others include), this is not a drawback. Our tests show

that for all the multimedia PCs and upgrade kits, additional amplification is required to drive anything but headphones or the smallest and most efficient speakers; none of the units could generate even 1 watt of power per channel with an 8-ohm load (the normal load for a standard stereo speaker).

In comparison with the Media Vision Upgrade Kit, the other multimedia PCs and upgrade kits offered considerably poorer scores on the Frequency Response test and the Sensitivity (Line Input) test. The CompuAdd Multimedia Upgrade Kit and the CompuAdd 320sc (both using the same audio componentry) produced midrange scores on the Total Harmonic Distortion (Line) test; the Sound Blaster Pro in the Creative Labs Upgrade Kit and the Tandy 2500 SX/20 provided the worst performance on that test. Interestingly, the Sound Blaster Pro in those systems offered the best performance on the Total Harmonic Distortion (Amplifier) test. Similarly, the units using the Sound Blaster Pro led the pack on the Signal-to-Noise Ratio (Amplifier) test. The best

### A LOOK AT PERFORMANCE

**The Sensitivity (Line Input) test** represents the minimum signal level (voltage) that must be supplied by an input source, such as the Audio Precision unit used in our tests. This input source is connected to the multimedia board's Amp or Aux input jack. Sensitivity is specified at a middle frequency of 1 kHz. A smaller number means greater sensitivity.

**The Full Output (Line) and Full Output (Amplifier) tests** measure the maximum voltage or power (watts) an audio board's amplifier can produce at a specified frequency. In the absence of a manufacturer-specified frequency range and distortion percentage, we used 1 kHz as the full output level. Results should fall between 0.5 and 2 volts for the Full

Output (Line) test, and the greater the deviation from this range, the poorer the board's score. For the Full Output (Amplifier) test, more wattage means better performance.

**The Total Harmonic Distortion (Line) and Total Harmonic Distortion (Amplifier) tests** express the ratio between the spurious harmonic products (distortion) of a signal and the true (undistorted) signal. It is measured when we drive the tested device to its full output levels (1 kHz in the absence of manufacturer specifications). Smaller percentages mean better performance.

|                                        | Sensitivity<br>(Line Input)<br>(volts) <sup>†</sup> | Full Output<br>(Line)<br>(volts) <sup>*</sup> | Full Output<br>(Amplifier)<br>(watts) <sup>††</sup> |
|----------------------------------------|-----------------------------------------------------|-----------------------------------------------|-----------------------------------------------------|
| CompuAdd Multimedia Upgrade Kit        | 0.50                                                | 1.70                                          | 0.55                                                |
| Creative Labs Multimedia Upgrade Kit   | 0.55                                                | 2.10                                          | 0.48                                                |
| Media Vision Multimedia PC Upgrade Kit | 0.05                                                | 1.95                                          | N/A                                                 |
| CompuAdd 320sc MPC 66405               | 0.52                                                | 1.74                                          | 0.68                                                |
| Tandy 2500 SX/20 Multimedia PC         | 0.52                                                | 1.98                                          | 0.46                                                |

N/A—Not applicable: The product could not perform this test.

L—Lower scores represent better performance. H—Higher scores represent better performance.

\* Optimal scores fall between 0.5 and 2 volts. † The optimal score is  $\pm 0$ .





Volume-Control Resolution test score came from the CompuAdd units.

#### HOW WE TESTED

We used Audio Precision's System One digital test equipment as the principal signal source and test instrument; besides generating tones, it processed the audio waveforms from the PCs and upgrade kits. This instrument uses a PC as a control, storage, and readout device and is the de facto standard for audio testing. Test signals for the CD-ROM units were supplied by a Columbia Broadcasting System CD-1 Test Disk, another industry standard.

We fed signals from the CD-ROM drives and audio boards into the Audio Precision and simultaneously played them on a wide-range stereo component system and monitored them on an oscilloscope. We used an external ground wire between the tested multimedia unit's chassis and the Audio Precision system's chassis to minimize hum.

To determine the sensitivity of each multimedia board's amplifier, we turned up all hardware and software gain

(volume) controls to the maximum. For our Sensitivity (Line Input) test, we fed a 1-kHz tone from the Audio Precision's generator into the audio board's Amp or Aux input jack.

The Full Output (Line) test, like all the line tests, tests each audio board's preamp output. To simulate a situation where the board drives an external amplifier or high-impedance headphones, the Audio Precision's 100,000-ohm resistor was connected to each audio board's left- and right-channel outputs. For the Full Output (Amplifier) test, to represent a pair of loudspeakers, we connected noninductive 8-ohm resistors to each audio board's outputs.

We checked the frequency response range for each multimedia system's audio board and CD-ROM drive over the audible spectrum, from 20 to 20,000 Hz. We also checked each audio board's variations in tone control over the same frequency range. The Audio Precision produced a sweep frequency tone, which we used to test the boards' frequency response. Each CD-ROM drive's fre-

quency response was similarly checked using the glide tone of the Columbia Broadcasting System's CD-1 test disk. We ran the Tone Control Range test by turning the controls to their extreme positions (full bass boost and treble cut, then full bass cut and treble boost).

For all tests, we used a Micro Express 386SX/20 with the multimedia upgrade kits. Like the CompuAdd 320sc MPC 66405, the Micro Express PC had 4MB of RAM (the Tandy 2500 SX/20 Multimedia PC shipped with 5MB of RAM). The Micro Express had a 105MB hard disk; the CompuAdd 320sc had a 120MB hard disk; and the Tandy 2500 SX/20 a 104MB disk.

The Media Vision Upgrade Kit's audio board is a preamp (or line amp) device only; because it does not include a power amplifier stage on-board, we could not perform the amplifier tests on this unit. Likewise, the Sound Blaster Pro audio board—part of the Creative Labs Multimedia Upgrade Kit and the Tandy 2500 SX/20—does not include adjustments for tone control, so we could not test their tone control range.

The **Signal-to-Noise Ratio (Line)** and **Signal-to-Noise Ratio (Amplifier)** tests express the ratio, in decibels (dB), between the Full Output test results and the residual noise level when we reduce the 1-kHz input signal to 0 Hz. In an unweighted signal-to-noise ratio measurement, all the frequencies that constitute the residual noise level are treated equally. Here, however, we use "A-weighted" signal-to-noise ratio measurements, in which the noise frequencies are weighted according to a standardized scale that approximates the human ear's sensitivity to low-level sounds. In an A-weighted signal-to-noise ratio measurement, for example, hiss frequencies are given greater prominence than hum frequencies, as the ear is relatively insensitive to very soft low-pitched sounds (hum). Bigger signal-to-noise ratios

represent better performance.

The **Frequency Response** test indicates the deviation in volume, measured in decibels (dB), with which an audio board's amplifier or CD-ROM drive processes the frequencies it is designed to handle. We measured the output across the audible frequency spectrum, from 20 Hz to 20,000 Hz. Since each multimedia system's audio board and CD-ROM drive gave an identical frequency response, we report only one test result for each system. A perfect result would be flat ( $\pm 0$  dB); the greater the deviation, the poorer the board's performance.

The **Tone Control Range** test expresses in decibels (dB) the amount by which an audio

board's amplifier can vary the proportions of treble and bass frequencies in comparison with a middle frequency. We measure the boost or cut available at 100 Hz (bass) and 10,000 Hz (treble) in comparison with the 1-kHz reference tone. Units that achieve the best scores on this test have high, matching scores for the bass and treble.

The **Volume-Control Resolution** test expresses in decibels the average change in an audio board's loudness as the volume level is increased one digital step at a time, starting from the "off" position and eventually reaching the maximum loudness. A smaller number of decibels per step indicates better volume-control resolution.

| Total Harmonic Distortion (Line)<br>(percentage) <sup>1</sup> | Total Harmonic Distortion (Amplifier)<br>(percentage) <sup>1</sup> | Signal-to-Noise Ratio (Line)<br>(decibels) <sup>11</sup> | Signal-to-Noise Ratio (Amplifier)<br>(decibels) <sup>11</sup> | Frequency Response<br>(decibels) <sup>7</sup> | Tone Control Range (100 Hz)<br>(decibels) <sup>11</sup> | Tone Control Range (10,000 Hz)<br>(decibels) <sup>11</sup> | Volume-Control Resolution<br>(decibels) <sup>1</sup> |
|---------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------|
| 0.26                                                          | 1.25                                                               | 74.70                                                    | 64.10                                                         | +0, -10                                       | +6, -10                                                 | +6, -13                                                    | 1                                                    |
| 0.46                                                          | 1.00                                                               | 75.60                                                    | 76.70                                                         | +0, -9                                        | N/A                                                     | N/A                                                        | 3.8                                                  |
| 0.14                                                          | N/A                                                                | 63.00                                                    | N/A                                                           | +0, -4                                        | +12, -8                                                 | +7.5, -7.5                                                 | 2                                                    |
| 0.27                                                          | 1.70                                                               | 76.20                                                    | 62.70                                                         | +0, -10                                       | +6, -10                                                 | +6, -13                                                    | 1                                                    |
| 0.46                                                          | 0.90                                                               | 74.80                                                    | 71.30                                                         | +0, -10                                       | N/A                                                     | N/A                                                        | 3.8                                                  |





## PC BENCHMARK TESTS

These multimedia PCs compare favorably with our 386SX/20 historical average; both systems provide particularly impressive disk and video scores. But the CompuAdd 320sc MPC 66405 takes a big lead over the Tandy 2500 SX/20 Multimedia PC on our processor and memory tests.

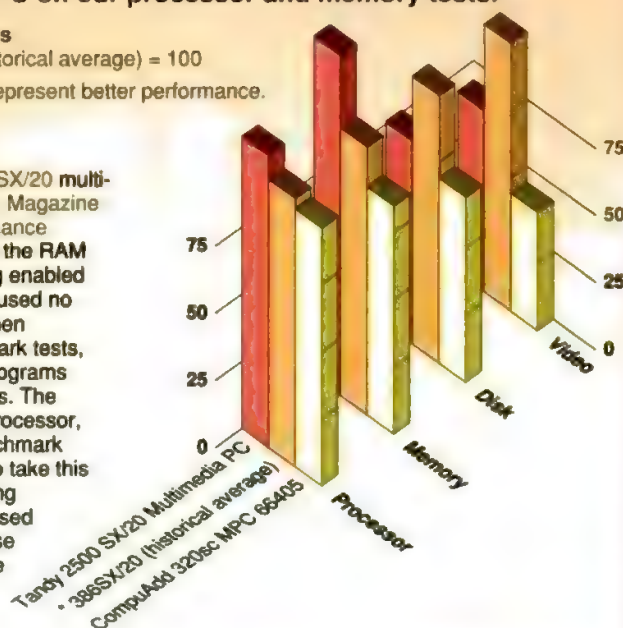
## Relative Times

386SX/20 (historical average) = 100

Shorter bars represent better performance.

## HOW WE TESTED

In testing these two 386SX/20 multimedia PCs, we used PC Magazine Labs' Hardware Performance Tests, Release 5.7, with the RAM cache and all shadowing enabled whenever possible. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds, so take this into account when making purchasing decisions based primarily on speed. These tests do not measure the machines' multimedia aspects.



## Elapsed Times (seconds)

Lower scores represent better performance.

|                                 | Processor | Memory | Disk  | Video |
|---------------------------------|-----------|--------|-------|-------|
| Tandy 2500 SX/20 Multimedia PC  | 3.55      | 0.66   | 47.15 | 1.37  |
| * 386SX/20 (historical average) | 3.26      | 0.52   | 62.28 | 2.01  |
| CompuAdd 320sc MPC 66405        | 3.12      | 0.44   | 42.88 | 0.88  |

\* Reported for comparison.

## WHAT THE NUMBERS MEAN

The two tested multimedia PCs compared favorably with our 386SX/20 historical average, in some cases surpassing that average by a fairly large margin. The CompuAdd 320sc MPC 66405 had the most impressive scores, excelling on the disk and video tests in particular. The presence of a fast Western Digital hard disk and controller largely accounts for its impressive disk score.

Systems with the Tseng video chip set have historically been winners in terms of the video test. This held true for the CompuAdd 320sc; its Tseng chip turned in top-notch performance. The CompuAdd 320sc's 32K static RAM cache also helped give this PC its more-than-satisfactory performance on our memory test.

The Tandy 2500 SX/20 Multimedia PC benefited from its 64K look-ahead buffer, which provided a better-than-average disk test result, although its performance on this test lagged slightly behind that of the CompuAdd 320sc. The Tandy PC's Paradise video chip also provided more-than-satisfactory performance, although again it was no match for the Tseng chip set found on the CompuAdd PC.

Despite its good disk and video scores, the Tandy 2500 SX/20 suffers from one-state operation, which impacts all performance aspects. The effects of

nector. This kit is a preamp device only. This is not a criticism; our tests show that all the other audio boards, even with a power amplification stage on-board, can't drive anything but small and efficient speakers. The Media Vision Upgrade Kit performed well when hooked to amplifier or self-amplified speakers.

On most of PC Magazine Labs' sonic tests, the kit managed some of the top scores, beating the competition on the Frequency Response and Total Harmonic Distortion (Line) tests. In comparison with the Media Vision Upgrade Kit's board, the other boards turned in much poorer scores on the Sensitivity (Line Input) test. It also did best on the Tone Control Range test and was in the middle of the pack on the Volume-Control Resolution test. Its one low score was on the Signal-to-Noise Ratio (Line) test.

The joystick/MIDI connector may pose a couple of problems. First among them is that the connector must fulfill two different purposes. If you want to hook up a MIDI keyboard, you will have to buy an optional \$69.95 MIDI connector box (it includes a MIDI cable). Another drawback will prove frustrating to those who find themselves in the midst of I/O address clashes: We could not disable the joystick/MIDI port.

## SOFTWARE HURDLES

The Media Vision Upgrade Kit's audio board supports simultaneous input and output across numerous channels, and Media Vision provides Windows modules that allow you to adjust the volume of each channel individually; for instance, you can lower the volume from an external CD player so that your simultaneous

voice-over will stand out more clearly.

In operation, this upgrade kit excels in most respects and never fails to dazzle passers-by, but our evaluation unit showed a few growing pains here as well. For instance, there were slight pauses in the video. We also experienced periodic problems with system crashes, quirky operation, and terminal applications errors. It is difficult to know whether these problems result from Microsoft's initial release of Multimedia Extensions or Media Vision's modules, but they are still problems.

Another drawback in the Media Vision control software concerns its rather non-standard Windows implementation. To open the menu that gives access to the Equalizer or Fade Mixer portions of the software, for instance, we had to open the Pro Mixer application, minimize it, then click on the minimized icon. We also had



one-state operation are clearly visible in the processor and memory test results, which were slightly slower than our historical average. In addition, the Tandy unit cannot accommodate a RAM cache; this also had a dampening effect on its memory performance.

■ The 80386 Instruction Mix benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall performance.

■ The Conventional Memory benchmark test measures the read/write speed of the first 640K of memory. Slower times can indicate the presence of memory wait states or memory chips rated at relatively slow access speeds.

■ The disk score is the sum of the small-record and large-record DOS File Access benchmark test times. Each test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. No software cache is employed.

■ The Direct to Screen benchmark test indicates the speed of the video adapter memory. A good score indicates that information can get to the screen quickly, particularly when programs bypass the computer's video BIOS.

to click on the minimized icon when we wanted to close down the mixer. Double clicking on the control box only minimized the mixer, though we didn't find this out until we noticed three or four mixer icons hanging out at the bottom of the screen. The company says it has fixed this problem in the latest software release.

Unlike the CompuAdd Multimedia Upgrade Kit, the Media Vision Upgrade Kit also lacks any one screen that lets you control the system volume and initiate system activity. So if you want to play a CD and the volume doesn't happen to be at precisely the right level, you must start the Windows Music Box, press Play, then call up the mixer to adjust the volume.

While these problems may keep the Media Vision Upgrade Kit from seeming just right, they don't detract to the point of making it an undesirable product, espe-



**Media Vision Multimedia PC Upgrade Kit**  
Media Vision Inc., 47221 Fremont Blvd.,  
Fremont, CA 94538; 800-348-7116,  
510-770-8600.

List Price: \$995.

Requires: 10-MHz 80286 PC or better, 2MB RAM, 30MB hard disk, VGA monitor and adapter or better.

In Short: The Media Vision Multimedia PC Upgrade Kit provides the best waveform audio performance of this roundup. It also includes welcome extras, such as the ability to support simultaneous input and output across numerous channels, Microsoft Windows modules that allow you to adjust each channel's volume individually, and superb installation documentation. Some quirks in operation, the lack of on-board amplification, and more minor annoyances are drawbacks, however.

CIRCLE 478 ON READER SERVICE CARD

cially if you find it at a bargain price. The company's second multimedia upgrade kit, a \$1,295 under-the-monitor external unit dubbed the CDPC MPC Upgrade Kit, did not make it off the production line in time for this review but promises to improve considerably upon the audio capabilities of the initial offering.

The new kit, an attractive external unit that also houses an amplifier, two speakers, and a condenser microphone, will offer 16-bit CD-audio performance comparable to that of audio CD players, as well as a 44-kHz stereo sampling rate. All of the kits reviewed here offer only 8-bit performance and are subject to the electrical noise generated by the PC power supply. The forthcoming external kit will also add amplified speaker outputs and a new synthesizer chip, the Yamaha YMF262. (A forthcoming version of the Pro AudioSpectrum will reportedly implement at least some of these enhancements as well.) If you want to make the most out of multimedia, the current Media Vision Multimedia PC Upgrade Kit is an acceptable choice, but the promised upgrade seems worth the wait.

#### COMPUADD COMPUTER CORP.

### CompuAdd 320sc MPC 66405

**BY MITT JONES** Base-priced at \$2,995, the 20-MHz 386SX CompuAdd 320sc MPC 66405 comes with everything you will need to get up and running with multimedia, including a set of inexpensive bookshelf speakers, speaker cables, and a clip-on mike. Unfortunately, while our \$3,300 evaluation unit performed nicely and seemed well-constructed, it provided little evidence that you're better off buying a multimedia PC (MPC) rather than a PC and a separate MPC upgrade kit.

CompuAdd Computer Corp. arrived at this model by adding the speakers, mike, and mouse to its \$1,069 CompuAdd Multimedia Upgrade Kit, which we also review in this issue. The CompuAdd 320sc doesn't come with a joystick adapter like the standalone CompuAdd Upgrade Kit does; rather, it integrates joystick support onto the motherboard. The CompuAdd 320sc is already shipping with the Voyetra multimedia software slated for forthcoming free shipment with the kit.

The tested configuration included 4MB of RAM instead of the base-priced configuration's 2MB, and a 120MB hard disk instead of the base-priced system's 80MB model; it also came with CompuAdd's high-resolution monitor and a 32K static-RAM cache.

Of course, the CD-ROM drive and multimedia board come already installed, a big advantage for those wary of taking a screwdriver to the system. As with the upgrade kit itself, however, CompuAdd failed to present any sort of unified documentation for the system as a whole. For instance, we received two booklets entitled "Read Me First." One booklet detailed cable hookups for a completely different system, and the other breezed through cable hookups for systems across the CompuAdd line. Neither mentioned the CD-ROM drive, speakers, nor Microsoft Windows with Multimedia Extensions 1.0. As with the CompuAdd Upgrade Kit, documentation for the PC's multimedia elements consisted of separate manuals for each component, and nowhere was there mention of CompuAdd's additions to Multimedia Windows. The company reports that it ships unified





## MULTIMEDIA

### PCs and Upgrade Kits

card. Our only complaint concerning the expansion board has to do with the one 8-bit and one 16-bit slot on the right side of the passive backplane. The small space between the backplane and the 200-watt power supply may force you to remove the power supply temporarily to provide clearance when installing an adapter.

The CompuAdd 320sc supports memory expansion up to 32MB on the motherboard, a figure that shouldn't leave anybody hungry, and can also handle a 20-MHz 80387SX math coprocessor. The Austek RAM cache controller allowed the test unit's standard 32K cache supplied with 35-nanosecond static RAM to be expanded to a maximum of 64K.

As you would expect, on PC Magazine Labs' sonic performance tests, the CompuAdd 320sc performed almost identically with the CompuAdd Upgrade Kit we installed in our Micro Express test-bed PC. Any differences between the two could only be measured on an oscilloscope and not by ear.

The CompuAdd 320sc comes with quality components, performs well, seems built to last, and is protected by a one-year parts-and-labor warranty and free, toll-free technical support; as a low-profile 386SX-based system, one could do a good bit worse. Configured as a multimedia PC, however, this system could use a lower price and the capability to add a second internal floppy disk drive. As with the CompuAdd Upgrade Kit, this PC could also benefit from a boost in multimedia audio capabilities. For the time being, the CompuAdd 320sc MPC 66405 is not a bad buy, but it simply is not a compelling one for multimedia enthusiasts.

#### TANDY CORP.

### *Tandy 2500 SX/20 Multimedia PC*

**BY WENDY DUGAS PÉREZ** Tandy Corp. seems to have forgotten that its Tandy 2500 SX/20 Multimedia PC is still a PC. For \$4,946.90, you get a packed system—5MB of RAM, a 105MB hard disk, a 3.5-inch floppy disk drive, a 1,024-by-768 Tandy VGM-440 monitor, a Tandy internal CD-ROM drive, the Sound Blaster Pro audio board, built-in parallel and serial ports, DOS 5.0, Microsoft Win-



#### Tandy 2500 SX/20 Multimedia PC

Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; 817-390-3011.

**List Price:** With 105MB hard disk, 5MB RAM, \$4,946.90.

**In Short:** The Tandy 2500 SX/20 Multimedia PC boasts very good disk and video performance, but in other respects its system scores are not as high as its list price might lead you to hope. As a PC, the system we reviewed lacks expansion room; as a multimedia entry, the included Sound Blaster Pro board provides equivalent audio performance to the same-model board included with the Creative Labs Multimedia Upgrade Kit. All told, the price is too high for what you get; less costly 386SXs equipped with a multimedia upgrade kit are better choices.

CIRCLE 480 ON READER SERVICE CARD



#### CompuAdd 320sc MPC 66405

CompuAdd Computer Corp., 12303 Technology Blvd., Austin, TX 78727; 800-627-1967.

**List Price:** With 120MB hard disk, 4MB RAM, \$3,300.

**In Short:** The CompuAdd 320sc MPC 66405 uses the CompuAdd Multimedia Upgrade Kit; this PC goes one step further by integrating joystick support onto the motherboard, saving you a slot. Excellent performance on our PC-specific tests makes this an interesting if somewhat costly choice if you are looking for a fast 386SX/20 machine. But this PC does not offer any compelling attractions as a multimedia device.

CIRCLE 479 ON READER SERVICE CARD

documentation that includes an addendum with detailed multimedia information, but we didn't receive this.

#### HOW IT HANDLED

Judged as a standard 20-MHz 386SX-based system, our evaluation unit fared quite well in terms of system performance, thanks in part to its 32K static-RAM cache. The PC fell a bit short when it came to the number of drive bays, but it still offered more room for expansion than did the Tandy 2500 SX/20 Multimedia PC. The sturdy low-profile chassis provides front access to only two drives—both as large as 5.25 inches, which means you will have to opt for an external model if you want either a second floppy disk drive or a tape backup unit. A third, internal 5.25-inch bay can accommodate one hard disk or, as in our evaluation unit, a 3.5-inch hard disk—an 18-millisecond Western Digital model—mounted sideways to leave room for another 3.5-inch device. On our disk test, the hard disk subsystem packaged with the PC provided excellent performance.

CompuAdd integrated all I/O ports and even the high-resolution Tseng-based 1,024-by-768 controller onto the motherboard. All slots in our system were free, except for one of the four 16-bit slots, which accommodated the multimedia

dows with Multimedia Extensions 1.0, and a two-button mouse. The machine was designed without much thought for expansion, however.

The unit is a fortress, with hinged metal plates covering the slots, motherboard, and drive bays, but its slimline design (4.5 by 15.5 by 15 inches) is limiting. There are provisions for only three 16-bit ISA cards, and two of these are used by the Creative Labs Upgrade Kit's audio board and CD-ROM interface. There are only two 3.5-inch drive bays; one is filled by the hard disk and the other by a floppy disk drive. The only other bay houses the 5.25-inch CD-ROM drive. There is no room for an internal 5.25-inch floppy disk drive, although Tandy does offer an external version for \$299.95. The unit is further limited by its 70-watt power supply, which is not switchable between 115 and 230 volts.

Our test system came from Tandy equipped with 5MB of memory, with 1MB standard on the motherboard, and 4MB of 80-nanosecond RAM taking up four SIMM slots. Since this unit can only use a maximum of 1MB SIMMs, you are limited to 5MB on the motherboard. To install more RAM, you must use the last remaining 16-bit slot. Note also that this

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## MULTIMEDIA TITLES: Growing by the Dozen

by Susan G. Thomas

If you still think that multimedia is just a passing trend, consider the following evidence. The Multimedia PC (MPC) Marketing Council was founded in March of 1991 to create standards in the burgeoning multimedia market. By the end of 1991, approximately 35 MPC-logo multimedia applications had shipped; many were CD-ROM converts from traditional software packages. By the end of 1992, Microsoft will be shipping all its Windows-based applications on CD-ROM.

Reference and educational tools are the most popular multimedia applications now. Expect these to become more visually and aurally interesting by the end of 1992, as record and playback waveform audio and full-motion video become more viable. The same goes for MPC-logo games. Right now, the only MPC-logo business application shipping is *Microsoft Works for Windows, Multimedia Edition* (\$199), but Council members predict that on-line tutorials in some business applications will go fully multimedia in the coming months.

We have compiled a brief list of some interesting and currently shipping MPC-logo titles. Take a look.

### YOUR SENSES AS REFERENCES: MULTIMEDIA REFERENCE TOOLS

Taking advantage of CD-ROM's vast database capacity, reference tools deliver the facts in a modality that suits you. Here are a few worth exploring:

#### **American Vista**

A view of the country, with maps of each state (provided by Hammond) illustrating political, topographical, industrial, and agricultural features. Applied Optical Media Corp.; 1450 Boot Rd., #400, West Chester, PA 19380; 215-429-3701. **List Price:** \$79.95.

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#### **Multimedia Encyclopedia for Windows**

This impressive reference tool

includes 15,000 pictures, maps, and graphs; 45 animation sequences; and 5,000 charts and diagrams. This CD ships with some of the PCs and upgrade kits reviewed here.

Compton's New Media, 722 Genevieve Ave., #M, Solana Beach, CA 92075; 800-533-0130. **List Price:** \$895.

CIRCLE 481 ON READER SERVICE CARD

#### **Microsoft Bookshelf for Windows**

A compilation of *The American Heritage Dictionary*, *The Concise Columbia Encyclopedia*, *The Hammond Atlas*, and other reference books, *Microsoft Bookshelf for Windows* includes a range of animation sequences, word pronunciations, and music. Creative Labs includes this with its Multimedia Upgrade Kit. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400. **List Price:** \$195.

CIRCLE 482 ON READER SERVICE CARD

### TEACH YOURSELF: MULTIMEDIA EDUCATION SOFTWARE

Multimedia education software runs the gamut—from narrated and animated stories for preschoolers to a full explication of Beethoven's Symphony Number 9, right down to the ritornello. Some good ones:

#### **Living Books:**

##### **Just Grandma and Me**

Targeted at children three to ten years old, *Just Grandma and Me* speaks and has animated characters, original music, and sound effects. Text appears on each screen in large type, just as it does in real storybooks. Broderbund Software, 17 Paul Dr., San Rafael, CA 94903; 800-521-6263. **List Price:** \$49.95.

CIRCLE 484 ON READER SERVICE CARD

##### **Multimedia Beethoven: The Ninth Symphony**

This CD was designed by a UCLA music professor to explicate the component parts of the symphony. By pointing and clicking, you can hear any other part of a particular movement while reading a history of the preeminent Romantic composer. The Vienna Philharmonic performs.

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400. **List Price:** \$79.95.

CIRCLE 485 ON READER SERVICE CARD

#### **Playing with Language**

Six years ago, a research group at Syracuse University conducted a study to determine how using multimedia could help children learn languages. The group's findings are incorporated into *Introductory Games in French* and *Introductory Games in Spanish*. Both applications use memory tests; jigsaw puzzles in vivid graphics; and teach over 200 foreign-language words and phrases, aiming for one- to two-year proficiency. Syracuse Language Systems, 719 E. Genesee St., Syracuse, NY 13210; 315-478-6729. **List Price:** \$895 each.

CIRCLE 486 ON READER SERVICE CARD

### MULTIMEDIA HEAD GAMES

Right now, most shipping MPC-logo games are educational, though there are certainly some just-for-fun offerings. Maxis's *Simcity*, the award-winning game that lets you plan and govern your own city, should be released with the MPC logo soon. Here are a few to consider now:

#### **Amanda Stories**

This CD package is a fully interactive series of animated stories for young children—no reading required. Pointing and clicking on different cartoon characters, kids create different stories each time they play. The Voyager Co., 1351 Pacific Coast Hwy., Santa Monica, CA 90401; 800-446-2001. **List Price:** \$59.95.

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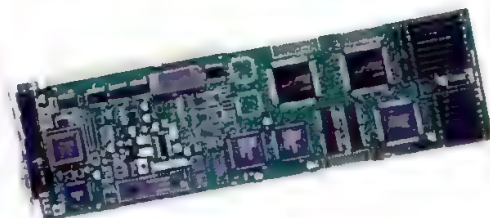
#### **Jones in the Fast Lane**

This game, shipping with some of the multimedia upgrade kits and PCs reviewed here, is like the old Parker Brothers board game *Life*, but updated for the nineties. Compete for success by playing with digitized characters instead of game pieces. Sierra On-Line, P.O. Box 485, Coarsegold, CA 93614; 800-326-6654, 415-597-5555. **List Price:** \$69.95.

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## BYTE

### USER'S COLUMN

#### Sound Blaster

One of the boards we installed in the Arche 486 was Sound Blaster. With its associated software, it has quietly (no pun intended, but what the heck) become the standard sound system for advanced PCs. The Roland board has much higher sound quality for a higher price, but for anything short of professional music quality, Sound Blaster is good enough.

There are lots of other accessories you can get for Sound Blaster, including musical instrument software and a voice editor. Sound Blaster has become the standard sound board, if not for the industry, at least here at Chaos Manor. Recommended.

Jerry Pournelle

## COMPUTE

### SNEAK PEEKS

#### SOUND BLASTER PRO

In just two years, the Sound Blaster has become one of the most widely-supported PC sound cards. It's easy to see why. The Sound Blaster contains an 11-voice FM synthesizer that makes it fully compatible with the popular Ad Lib Music Card. The day it hit store shelves, the Sound Blaster could be used with hundreds of Ad Lib compatible games and educational programs. To add even more value, the original Sound Blaster included a DAC (Digital to Analog Converter) for digitized voice and sound effects, a microphone jack for voice input, a built-in game port, a built-in 4-watt amplifier, and an optional MIDI interface.

The built-in mixer makes the Sound Blaster Pro fully compliant with Microsoft's Multimedia Level 1 Extensions to Windows. Multimedia software will be able to fade-in, fade-out, and pan the various audio sources to create elaborate sound montages.

The Sound Blaster Pro includes a CD-ROM interface for either an internal or external CD-ROM player.

There's also an internal connector for CD-Audio. The MIDI interface is compatible with the original Sound Blaster's MIDI interface, but adds the MIDI time-stamp that's part of Microsoft's new multimedia standard.

All in all, the Sound Blaster Pro is chock-full of new features, yet it's fully compatible with its younger brother.

DAVID ENGLISH

Scheduled Release: September 1991  
For IBM PC and compatibles—\$299.95

CREATIVE LABS  
2050 Duane Ave.  
Santa Clara, CA 95054  
(408) 986-1461

PC HOME JOURNAL

#### SOUND BLASTER DOES IT ALL

Review by Harvey Bernstein

The Sound Blaster has so many audio applications packed into one half-sized board that it almost boggles the mind. First, it has an 11-voice stereo music synthesizer that is fully compatible with the widely used AdLib sound format. Older software that only supports the AdLib board will automatically turn on the AdLib mode — no adjustment by the user is necessary. A separate channel is exclusively for reproducing digitized speech. A microphone jack on the back of the card allows you to digitize your own input voices. With a 4-watt stereo amplifier built in, you can run speakers or headphones directly from the card — no additional amplification is necessary. A standard joystick port also doubles as a MIDI interface, allowing you to connect a synthesizer or any other MIDI instrument. Combine this with an excellent library of software, and it is easy to see why the Sound Blaster has become so popular.

The Sound Blaster is the Sound Blaster worth the investment. Yes, yes, a thousand times yes! When you hear how much the Sound Blaster increases the capabilities of your PC, you'll wonder how you ever got along without one.

PC

## PC GAMES

#### SOUND BLASTER PRO

By Barry Brenesal

The Marines may look for a few good men, but any PC game player will gladly settle for a single good sound card: one that plays both Sound Blaster and AdLib scores, one that doesn't fry your other boards, one that never draws attention to itself, one that delivers all the sophisticated sound effects and music bundled into the latest batch of game software.

Look no further: Sound Blaster Pro does it all, and more. At \$299.95 it's not cheap, but neither are its features.

Testing: One, Two . . .

Installing Sound Blaster Pro is a snap. The 16-bit card slips easily into place. It comes with . . .

Trying out Sound Blaster Pro is a treat. It's got great frequency response — that's the difference between listening to a film score on a tinny, muffled AM radio and hearing it on a stereo movie-theater speaker system. The orchestral soundtrack to Origin's Wing Commander is a good example, because it changes mood and melody to match the success of your current battle. Add Sound Blaster Pro to a good VGA screen and a responsive joystick (which you can plug into Sound Blaster Pro's joystick port), and the illusion of dogfighting aliens in a George Lucas-style film becomes 3-D, symphonic reality.

Another plus is the absence of the annoying background . . .

In short, Creative Labs' Sound Blaster Pro is a big winner. It's quick to install, easy to use, full-featured, and compatible with Sound Blaster and AdLib files. Signal response is excellent. And don't forget . . .

Now you can get the number one sound card as part of our new Multimedia Upgrade Kit. Which also comes with a MIDI kit, an internal CD-ROM drive and 5 CD-ROM titles, including Microsoft® Bookshelf® and Windows™ with Multimedia Extensions. In all, \$2,000 worth of goodies for just under \$850.

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Creative Labs, Inc., 2050 Duane Ave., Santa Clara, CA 95054 Telephone: (408) 986-1461 Fax: (408) 986-1777 For international information, fax Creative Technology at (65) 773 0353. Sound Blaster is a registered trademark of Creative Labs, Inc. Windows and Bookshelf are registered trademarks of Microsoft Corporation.

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system does not include provisions for a RAM cache.

The unit's Tandy motherboard is the same one the company ships with all its 386SX/20s. It contains an Intel microprocessor and a Headland chip set; you can turn on both the video and system BIOS shadowing. The 1,024-by-768 video, integrated onto the motherboard, has 512K of RAM installed (256K in the standard configuration). The Tandy 2500 SX/20 racked up very good scores on PC Magazine Labs' video test.

Although this unit does not have an 80387SX coprocessor installed, it is designed to accommodate one, which you can purchase for \$169.

#### HARD DISK AND CD-ROM DRIVES

For data storage, the unit uses a 105MB 17-millisecond Quantum IDE hard disk with a 64K look-ahead buffer. On our disk test, the 64K buffer helped the system achieve very impressive results, though not as impressive as the results for the CompuAdd 320sc MPC 66405.

The internal Tandy CDR-1000 CD-ROM drive has a proprietary interface. It does not use CD-ROM caddies, as do most CD-ROM drives. It is designed like a regular, easy-to-use stereo CD: Pull part of the unit out of the bay, lift the cover, and fit the CD inside. Then you simply push the whole unit back into the bay. This drive performed on a par with the other CD-ROM drives on our Sequential Throughput test. By running motion video, we were able to get smooth results once we increased the setting for the BUFFERS statement.

The Sound Blaster Pro, from Creative Labs, is the audio card Tandy chose to include with the test system. (For more information, see the Creative Labs Multimedia Upgrade Kit review earlier in this story.) On our sonic tests, the Sound Blaster Pro performed identically to the Sound Blaster Pro used by the Creative Labs Multimedia Upgrade Kit we tested in this roundup. Although this board produced slightly different results when we installed it on the Tandy PC and on the Micro



## MULTIMEDIA

### PCs and Upgrade Kits

Express test-bed, this is nothing you can distinguish by ear.

Tandy's base-priced configuration is priced at \$2,999 and includes most of the components that the \$4,946.90 tested configuration included. Different from the tested unit, however, it is equipped with only 2MB of RAM and a 52MB hard disk; instead of coming standard the Tandy VGM-100 monitor is a \$499.95 option, and the Tandy VGM-220 display costs \$399.95. Tandy's Super VGA monitor is available for \$649. DOS 5.0 and Multimedia Windows come with this system and the one we tested, but the company does not include any CD-ROM applications. Internal modems for the system range from a \$99.95 2,400-bps modem with MNP 2 to 5 in software to \$699.99 for a 9,600-bps modem.

The unit comes with a one-year parts-and-labor warranty. The company operates a 24-hour bulletin board service; technical support is free but requires a toll call.

You can purchase higher-end versions of the Tandy 2500 SX/20 Multimedia PC, including 386 25- and 33-MHz systems, with larger cases and more expansion options. All use the same Creative Labs Sound Blaster Pro audio board and Tandy CDR-1000 CD-ROM drive that came with the tested unit. If you already own at least a 386SX/20 system, don't opt to buy the Tandy model we reviewed if all you want is the multimedia capabilities; get a multimedia upgrade kit instead. If you don't already own a PC, there are plenty of other systems in the 386SX/20 class that provide better Processor and Memory scores at a lower cost than does the Tandy 2500 SX/20 Multimedia PC. Choose one of them and then get a multimedia upgrade kit to go with it. ■

*Susan G. Thomas is an editorial researcher at PC Magazine. Mitt Jones and Charles Petzold are contributing editors of PC Magazine. Wendy Dugas Pérez and John R. Quain are frequent contributors to PC Magazine.*

Should you already  
own a 386SX/20  
system, don't opt to  
buy the Tandy  
computer if all  
you want is  
the multimedia  
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*The new T3300SL*

# maybe you should get into politics.

If your need for power is on the scale of say, Napoleon, consider the new T3300SL. It offers a 25MHz 386SL microprocessor plus 64 KB cache for blazing speed and longer battery life. Not to mention an 80 or 120MB drive and a PCMCIA-compatible slot. And like its cousin the T2200SX, it offers a Nickel Hydride battery and a carbon-fiber reinforced case. So call 1-800-457-7777. Or if you want even more power, don't forget it's an election year.

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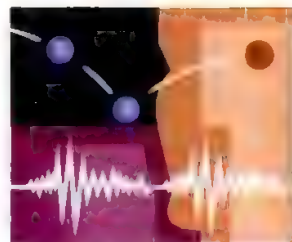
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**Perfecting the PC**



## MULTIMEDIA

These five MIDI sequencer programs, priced from \$99 to \$395, provide the tools you need to add music to your multimedia applications and presentations, and you don't have to be a musician to get harmonious results.

### MIDI SOFTWARE

# MIDI Goes Mainstream

by Robert Hendall

Since its introduction nearly ten years ago, MIDI (Musical Instrument Digital Interface) has revolutionized the music industry, putting advanced performing and recording capabilities in the hands of amateur musicians. Now, with support for MIDI in Multimedia Extensions for Microsoft Windows 1.0 and in the forthcoming Microsoft Windows, Version 3.1,





## MULTIMEDIA

### MIDI Software

MIDI stands poised to make its mark in the business world, too.

No matter how slick your on-screen presentations are, mastering the art of the soundtrack is the final step toward a truly professional production. After all, when was the last time you saw a television commercial or movie without music?

A little music behind the graphics in a presentation can help hold an audience's interest. On-screen advertising displays and PC-based information kiosks attract more attention when they play a few tunes. Music can make computer-based training fun—and more effective. Regardless of your presentation's content, music can elicit the audience response you want, be it excitement, confidence, or anxiety.

#### WHAT IT IS, WHAT IT DOES

MIDI is a digital protocol for the transmission of musical data, and its revolutionary nature lies in the unique way it handles music. Rather than encoding sounds, MIDI encodes every action performed on a MIDI musical instrument. While recording keyboard playing, for example, MIDI files keep a record of which keys are pressed, how hard, and

when. MIDI data can be stored on-disk in the form of a sequence and transmitted to any MIDI synthesizer to replicate the original performance.

MIDI sequencing packages, which let you create and edit MIDI music files, have proven a boon for professional musicians and music students. But how valuable are they for business users who want a little music to liven up a presentation or to help hold a user's interest in a computer-based training application? We've evaluated five sequencers priced from \$99 to \$395: Dynaware USA's *Ballade*, Twelve Tone Systems' *Cakewalk Professional*, Passport Designs' *Master Tracks Pro*, Dr. T's Music Software's *Prism*, and Voyetra Technologies' *Sequencer Plus Gold*.

Given the Microsoft Windows push into multimedia, it's a little funny that *Master Tracks Pro* is currently the only Windows application in the group; but all of the programs let you import and export Standard MIDI files, the format supported by Multimedia Extensions. They all work with Multimedia PC (MPC) audio boards or the Roland MPU-401 MIDI interface,

which is also supported by Multimedia Extensions, and can coexist in the same machine with an MPC card. At review time, a second Windows sequencer—Midisoft's *Midisoft Studio for Windows*—was almost ready, and most of the vendors of the DOS products have Windows versions in the works. The standards that Windows and the Multimedia PC specification bring are going to help move MIDI into the mainstream (see the sidebar "Midisoft Studio Comes to Windows").

Music via MIDI and digital audio is another addition to the arsenal of resources the PC offers for enhancing communication, much of which we now take for granted. On-screen presentation users think nothing of replacing their slide projectors with the unique graphics capabilities of the PC monitor, and managers are turning to the PC's interactive powers for customized training applications.

The multimedia programs that create such presentations play music stored in a MIDI file as a background event on either a synthesizer built into a PC audio card or an external MIDI sound generator connected to the PC.

Just as working effectively with PC graphics doesn't require artistic training, you don't have to be a musician to put MIDI to use for editing music. You do, however, need some basic knowledge and the right tools. MIDI sequencing packages, which let you create and edit MIDI files, are no longer just for professionals.



#### EDITORS' CHOICE

##### ■ *Master Tracks Pro*

For multimedia authors, *Master Tracks Pro* (\$395) offers many clear advantages over its competitors. Its use of the Microsoft Windows environment (it's the only Windows application in the reviewed group) makes it the most practical adjunct to Windows authoring tools; its full support for the Windows MIDI drivers and the MIDI Mapper lets you hear your sequences exactly as they'll sound when played back by another Windows application. And it provides the most well-balanced set of features for editing Standard MIDI files. Topping it off is the program's user interface—the most sophisticated and accessible of the products reviewed here.

Two fine DOS sequencers—*Cakewalk Professional* and *Sequencer Plus Gold*—deserve honorable mentions. Both packages are good performers with some

unique features useful for multimedia work, and they both carry more attractive price tags (\$249.00 and \$299.95, respectively) than *Master Tracks Pro*. In some ways, they better serve musicians, as well. *Sequencer Plus Gold* includes a comprehensive set of DOS drivers for MPC sound boards, but its quirky interface makes it a little hard to learn. *Cakewalk Professional* has a more accessible interface but provides very limited support for MPC boards.

Many users will be happiest with a low-end version of one of these three professional packages: *Cakewalk*, *Sequencer Plus Classic*, or *Trax*. But each one of these low-end versions lacks some features that nonmusicians could use for their work with multimedia. But you may find that sacrificing some functionality is worth the money you save.

#### THE MIDI ADVANTAGE

The Standard MIDI File format has become an industry-wide paradigm for storing sequences. Any Windows package that fully supports the Multimedia Extensions—ranging from Gold Disk's *Animation Works Interactive* to Aim-Tech's *Icon Author*—can read Standard MIDI Files as easily as it does .BMP graphics. These software packages will play the music as a background event on either a synthesizer built into the Multimedia PC's audio card, or an external MIDI sound generator connected to the audio card's MIDI Out port.

MIDI support is common among DOS multimedia packages, too, such as IBM's *Storyboard Live!* and Brightbill-Roberts & Co.'s *Show Partner F/X*. You can also expect MIDI technology to find its way into the screen show modules of many presentation graphics packages under Windows 3.1. All of these programs can play prerecorded music from the huge





## MULTIMEDIA

### MIDI Software

stock of existing Standard MIDI File libraries. Windows 3.1 itself will have a simple player/recorder. Hundreds of pre-recorded MIDI files are available from a wide variety of sources, including bulletin boards, MIDI sequencer vendors, and companies that specialize in producing MIDI music files. Costs vary widely, and some pieces are copyrighted.

For multimedia, MIDI has a number of advantages over waveform and Red Book audio, the other two formats for storing audio in Windows. Foremost is its frugal use of disk space. You can store half an hour of stereo music in about 200K of MIDI files, while the same file would gobble over 300MB in CD-quality waveform or Red Book audio format. If you want to put music behind speech that is recorded in a waveform file, you can play a MIDI file simultaneously with it in Windows, but you can't play two waveform files at once.

MIDI files also allow unequaled flexibility in editing. With the aid of a sequencer, you can change elements such as tempos and instrument sounds, all with-

out knowing anything about music, except what you like to hear. Even with minimal music training, you can create your own sequences either by recording them from a MIDI keyboard connected to the MIDI In port on your MPC audio card or MPU-401 card, or by entering notes at the computer screen.

MIDI also has some disadvantages. Sound quality depends largely on the MIDI hardware. The FM synthesis provided by most MPC cards offers generally poor sound, suitable only for replicating percussion and some electrical instruments. To obtain convincing acoustic instrument sounds (for example, flute, trumpet, or strings) you'll need a MIDI sound generator that uses ROM samples—actual instrument sounds stored as digitized audio—such as Roland's \$795 SC-55 Sound Canvas module, which can plug into any MPC-standard machine. (An expansion board version of the Sound Canvas, the SCC-1 GS Sound Card, recently became available as well.) Another

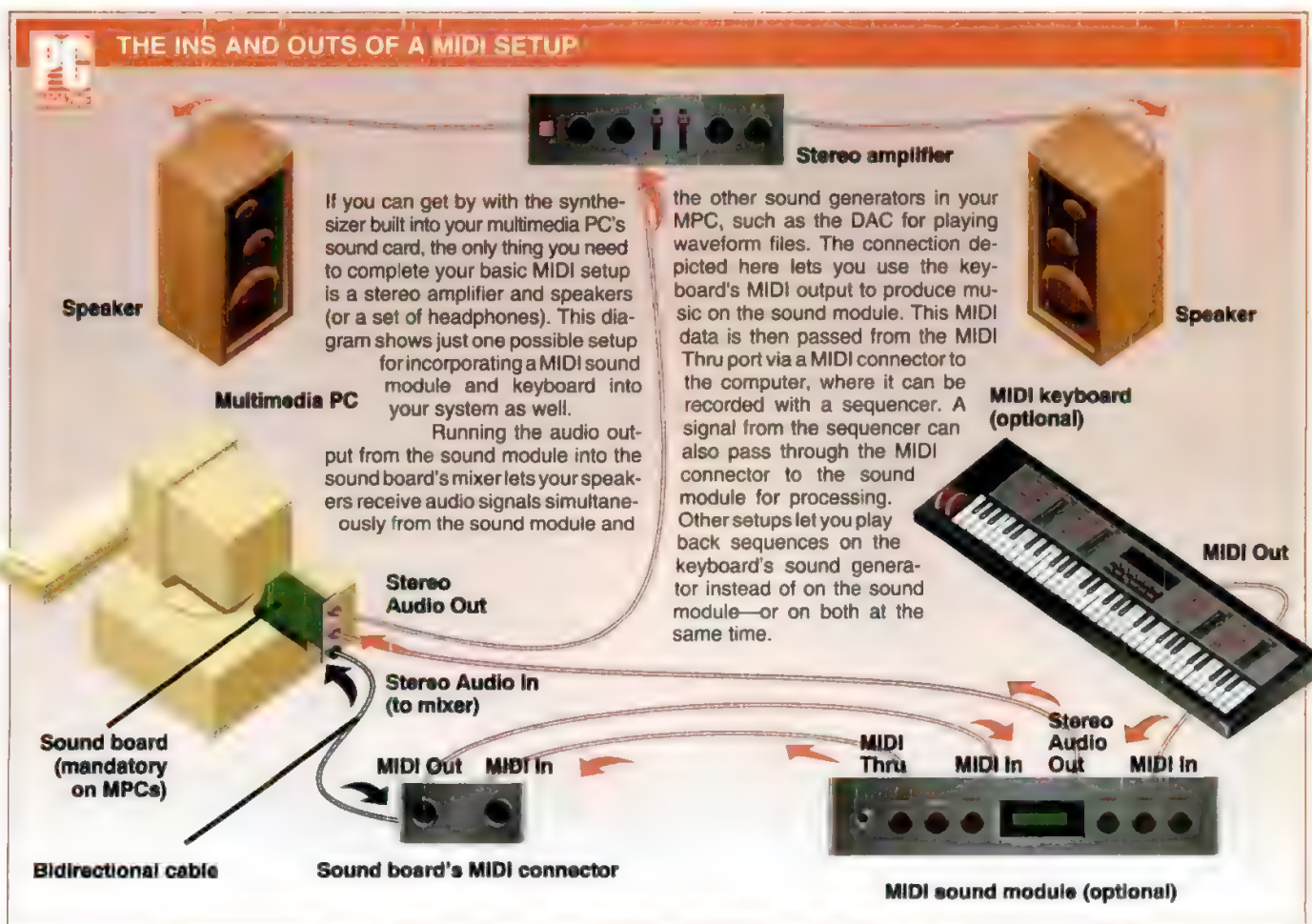
drawback is that different synthesizers respond differently to some MIDI data, causing potential problems when playing a sequence on a synthesizer other than the one for which it was created.

MIDI allows up to 16 separate channels for sending and receiving data. You can assign different instrument sounds (or patches) to individual channels, creating the effect of an instrumental ensemble. The biggest incompatibility is in *patch layout*—the correspondence between the patches and the numbers used to select them—which can differ from one synthesizer to the next.

#### MIDI UNDER WINDOWS

Recognizing that users want plug-and-play MIDI, Microsoft and the Multimedia PC Council have taken some steps to minimize MIDI compatibility problems in Multimedia Extensions for Microsoft Windows.

Unfortunately, support for General MIDI is not yet widespread among synthesizer vendors. To compensate for this, Multimedia Extensions includes a Con-







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trol Panel utility called the MIDI Mapper. It remaps patch, channel, and drum note assignments during playback from General MIDI to the layouts used by various synthesizers and sound modules. If you wish to play a sequence that doesn't conform to General MIDI or to the patch layout of the synthesizer in your system, you can create your own MIDI Mapper file.

This is where a sequencer comes in. Nonmusicians can easily tailor a sequence to match the peculiarities of their MIDI hardware. When you want to distribute sequences with a multimedia application you have authored, it lets you convert them, if necessary, to Extended Multitimbral (high-end) synthesizers or the Base

Multitimbral (low-end) format so you can be reasonably confident they will play acceptably on any MPC. On top of this, sequencers are powerful tools for enhancing your music with effects ranging from fade-outs and panning to instrument doubling (see the sidebar "Putting a Sequencer to Work for Multimedia").

#### SEQUENCER FEATURES

Sequencers use the metaphor of a multi-track tape recorder for recording and editing music. Normally, each instrumental part (corresponding to a separate instrument in a live performance) resides on a separate track assigned to its own MIDI

channel. Every sequencer has a main screen that shows track names, and typically allows you to change initial settings (such as patch and volume) for each track.

For a bird's-eye view of your sequence, there's usually a screen that shows all tracks simultaneously with each measure represented by a symbol—usually a solid square box for measures containing music, and a different symbol for empty measures. Here, you can select blocks on one or several tracks at once for global editing, cutting, or pasting.

All sequencers offer at least one type of note editor for viewing and editing individual notes. The best option is a piano-roll note editor, which displays the notes

## MIDI AND MUSIC: Defining the Terms

by Robert Kendall

### MIDI TERMS

**aftertouch message** ■ On a MIDI keyboard, the amount of finger pressure on a key after the initial attack. How far the key is depressed determines the amount of vibrato—a slight pitch waver that gives a more natural sound to the simulation of many instruments.

**channel** ■ An individual transmission "line" that can carry the sound of a separate instrument. Each MIDI port allows up to 16 separate channels for sending or receiving data, and each channel can function as a separate instrument in an ensemble, each using its own patch and responding independently to continuous controllers.

**clock pulse** ■ The smallest unit of time a sequencer can work with. The accuracy with which a sequencer handles subtle rhythmic nuances depends on its timing resolution in clock pulses per quarter note; a quarter note is the default unit of time for one beat.

**continuous controller** ■ A MIDI message that can change a synthesizer setting in a MIDI sequence file. There are 128 different controllers, and each one is associated with a number that identifies its function. Some controllers have standardized assignments. Con-

troller 7, for example, determines the loudness of notes received on a MIDI channel. Each time a synthesizer receives a Controller 7 message, it adjusts its volume to match the value stored in the controller, which can range from 0 to 127.

**FM synthesis** ■ The least-expensive method for producing synthesized sound. FM synthesis uses one sine wave to control the frequency of another, and most of the synthesizers built into PC audio boards use this method. But MIDI keyboards and sound modules usually use more sophisticated synthesis techniques for greater accuracy in reproducing the sounds of different instruments.

**key velocity value** ■ A value that MIDI keyboards generate according to how hard a key is struck. Each MIDI note has a key velocity value attached to it to determine its loudness at the moment of attack.

**marker** ■ A text label that can be attached to a point in a sequence; such labels delineate musical sections and make editing easier. The Standard MIDI File format supports markers, but only *MasterTracks Pro* can import and export them.

**panning** ■ A feature that positions sounds to the left or right in a stereo

sound field, creating the effect of different instruments playing in different parts of the room. You need the ability to control panning to take advantage of the stereo capabilities of high-end synthesizers and some MPC boards.

**patch** ■ A set of tone-generating parameters that determines one of the instrument sounds (such as flute or jazz guitar) produced by a synthesizer. Patches are selected by labels called *program numbers*.

**pitch bend** ■ A gradual change in a tone's frequency (highness or lowness). This can replicate glissando effects (like moving the slide of a trombone); it can also be used for vibrato or to produce more natural note attacks on some instruments.

**ports** ■ Synthesizers and PC MIDI interface cards are equipped with MIDI In and Out ports that receive and transmit musical data from other MIDI devices via MIDI cables. A MIDI Through port retransmits data exactly as it is received via the MIDI In port.

**program number** ■ See *patch*.

**Punch In/Out** ■ The beginning (In) and end (Out) notations for a selected portion of music to be rerecorded. Only the selected portion will be replaced by a new performance.



of each track as horizontal bars on a grid, with the vertical axis representing pitch and the horizontal axis representing time. This notation system resembles the piano rolls used to notate music for old player pianos. Unlike conventional musical notation, it provides exact visual equivalents for the actual sounds that nonmusicians will be able to follow with just a little practice.

Some sequencers offer an event list editor, which shows MIDI events—notes and continuous controllers—and their parameters as a textual listing in the order they appear in the song. *Ballade's* note editor uses conventional musical notation.

A couple of the sequencers reviewed

here support MPC boards under DOS, and this poses a special problem. Boards such as Creative Labs' Sound Blaster Pro and Media Vision's Pro AudioSpectrum don't store patches in their synthesizer chips, but rather download them from a software driver. This means that if the patches provided by the sequencer vendor's DOS driver for the board don't emulate the patches in the Windows driver you'll be using, the sequence can sound quite different when you play it back from a Windows application. To exacerbate the problem, different-sounding Windows drivers are sometimes available for the same board.

**quantization** ■ The practice of shifting notes to the nearest beat (or specified fraction of a beat) in order to remove rhythmic inaccuracies. This function can be performed during or after recording.

**Standard MIDI File** ■ A generic-sequence data file format (.MID), which comes in three types. The most common and practical file is Type 1, which stores different musical "voices" on separate tracks. Type 0 stores all music on a single track; it cannot accommodate tempo changes or certain other kinds of events. The rarely used Type 2 format stores music as blocks, with instructions for ordering and repeating the blocks.

**step recording** ■ The practice of recording pitches one at a time on a MIDI keyboard device, while selecting desired durations from the computer screen.

**system-exclusive data** ■ Proprietary, device-specific information that synthesizers can transmit in addition to data that conforms to the MIDI specification. This includes the contents of patches and the settings for many effects.

#### MUSIC TERMS

**accelerando** ■ A gradual quickening of tempo.

**crescendo** ■ A gradual increase in volume.

**decrescendo** ■ A gradual decrease in volume.

**measures** ■ Also known as bars; the simple units of rhythm in which music is organized. They are marked in musical notation by bar lines. Each measure contains a fixed number of beats (usually 2, 3, 4, or 6).

**ritard or ritardando** ■ A gradual slowing of tempo.

#### OTHER MPC AUDIO TERMS

**Red Book audio** ■ The digitized audio format used by commercial audio CDs (often referred to as CD-audio). The 16-bit 44.1-KHz data that conforms to this format can be stored only on CD or CD-ROM.

**waveform** ■ The format that Microsoft Windows with Multimedia Extensions uses for storing digitized audio on-disk. Files of this type are created by sampling—the digital equivalent of tape recording. The larger the sample size and the higher the sampling rate, the better the sound. Waveform files can use either 8-bit or 16-bit samples and sampling rates of 11.025, 22.05, or 44.1 KHz, and they can be stereo or mono. The abbreviation for this file format is .WAV. ■

#### BEYOND SEQUENCING

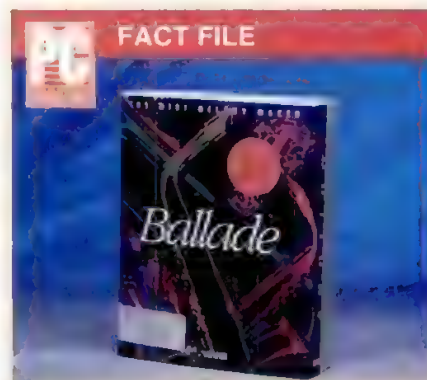
As MIDI makes further inroads into the computing mainstream, it should become easier for the business user to employ it. Falling hardware prices will eventually make high-quality MIDI sound generators widely available on sound boards. The growing acceptance of General MIDI and the MPC sequence format will make compatibility less of a problem. And more and more MIDI software will address the needs of businesspeople working in a multimedia environment.

Many businesspeople and marketers already create colorful, informative slides on their PCs and some people are edging into the simple graphics animation arena. Sound is, of course, the next logical step, and MIDI sequencing software will help you take it.

### Ballade

Dynaware USA's *Ballade*, Version 2.51, is designed to make creating sequences easy for the amateur musician. While an elegant graphical interface and innovative features make it an excellent \$195 home recording studio for the novice, *Ballade* is far less successful as a tool for editing prerecorded MIDI files.

*Ballade's* most unique feature is a visually stunning main screen that emulates a studio mixing console. Each track



#### Ballade, Version 2.51

Dynaware USA Inc., 950 Tower Ln., #1150, Foster City, CA 94404; 415-349-5700.

List Price: \$195.

Requires: 640K RAM, MIDI interface, DOS 2.1 or later.

In Short: *Ballade*, Version 2.51, offers amateur musicians an excellent tool for creating their own sequences, but it is woefully inadequate for working with standard MIDI files.

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## MULTIMEDIA

### MIDI Software

is represented by a slider for controlling volume via Controller 7, a push button for muting, a knob for panning, and a level meter for monitoring audio output. There's also a single slider for general volume, and tape recorder buttons let you start and stop the sequence as well as fast forward and rewind.

As a sequence plays, the sliders and knobs move in response to any embedded volume and panning controllers. You can change these parameters, as well as program and channel numbers, during playback by manipulating the console controls with the mouse. A tempo indicator also lets you proportionally scale all tempos in the song by clicking on it. Tempo



**Ballade's striking main screen emulates a mixer console. You can move the sliders and knobs with the mouse to adjust the volume and panning for each track.**

and channel changes stay intact, but unfortunately, all other parameters, such as volume and panning, are reset as soon as playback stops, which severely limits the utility of this slick display.

The tools for making permanent changes are also engaging and innovative. A separate song screen shows your music one track at a time in conventional notation, and when you insert elements such as crescendos or ritards, they're depicted by the conventional musical symbols. You create these gradations of volume or tempo by manipulating line graphs in a dialog box, dragging the beginning points and endpoints of the lines to the starting and ending values, and then by selecting a line curve.

Other global-editing features are limited, though. You can transpose pitches and change Controller 7 for volume, but there is no way to edit key velocity or note durations globally.

### NOTATION SCREEN FOR MUSIC READERS

If you read music, editing with the notation screen is an easy matter of selecting note symbols from a palette and dragging them onto the staff. The same palette provides note durations for step recording, which complements the program's other well-rounded recording features.

To change program numbers, *Ballade* lets you choose from a list of instrument names, providing templates for General MIDI, the MT-32, and several other synthesizers. There's also an elegant graphical patch editor for changing the sound parameters of an MT-32 sound module.

The notation screen—although great for musicians who want to print their music—is no substitute for a piano-roll editor. Despite a moving cursor for playback, nonmusicians will find the screen cryptic, and even professional musicians will have trouble using it to decipher complex music, since it doesn't always display notes in the most readable manner. Conventional notation also lacks the rhythmic precision of a piano-roll editor.

Another notable omission is a measures screen for viewing and editing multiple tracks. You must do all cutting and pasting from the notation screen, which will display only one track at a time. You can cut-and-paste sections on all tracks at once, but there are limits on cutting and pasting from one track to another.

The main screen and notation screen aren't as well integrated as they should be. You must stop playback before you switch between them, and once in the new screen, you'll find yourself in a different place in the sequence.

For multimedia authors, *Ballade's* biggest failing is its inadequate handling of Standard MIDI Files. It limits you to ten tracks, which is adequate for many library sequences, but not for those in the format recommended by the MPC specification. Drum parts must be on a single track assigned to Channel 10. If you're using one of the many sequence libraries to assign each drum kit sound to a differ-

ent track, the tracks won't import. The import utility also corrupted many elements of our test file. Tempos were incorrect, and importing cut out the last few bars of one track and the last bar of another; track names were also stripped out.

*Ballade* doesn't support aftertouch and a number of the less common controllers. Another problem is that the controller and pitch bend messages that it does import don't show up in the editing screen. You can hear them, but you can't change them.

For amateur musicians who want to record and edit simple music, *Ballade* offers many advantages over the other packages reviewed here. For working with Standard MIDI Files, though, the program falls far short of the mark. Many of these problems may be rectified in the forthcoming Microsoft Windows version of the package, which will also allow up to 16 tracks and support markers.

## Cakewalk Professional

Although Twelve Tone Systems' *Cakewalk Professional*, Version 4.0e, can meet the needs of demanding professional musicians, using this full-featured \$249 sequencer for simpler tasks is still quite straightforward. Its clarity and ease of use garnered the original low-end incarnation of *Cakewalk* an Editors' Choice award in



**Cakewalk Professional, Version 4.0e**  
Twelve Tone Systems Inc., P.O. Box 760,  
Watertown, MA 02272; 800-234-1171, 617-  
273-4437.

**List Price:** *Cakewalk Professional*, \$249;  
*Cakewalk*, \$150; *Cakewalk Apprentice MIDI*  
*Starter Kit* with MIDI interface, \$199.

**Requires:** 640K RAM, MIDI interface, DOS  
3.0 or later.

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## PUTTING A SEQUENCER TO WORK FOR MULTIMEDIA

by Robert Kendall

To put these sequencers through their paces, we used a 16-MHz 386 equipped with two MIDI interfaces—Media Vision's MPC-compatible Pro Audio-Spectrum and a Roland MPU-401-compatible board. MIDI output went to a Roland SC-55 Sound Canvas sound module. A Yamaha SY22 keyboard was used for recording input.

Our testing procedure concentrated on functions that multimedia authors are likely to use when editing Standard MIDI Files from a library before adding them to an application or presentation. These features—outlined below—can all be used by nonmusicians, though some will require a little persistence and perhaps some natural musical aptitude to master them.

### IMPORTING AND EXPORTING

Accurate file conversion is a prime consideration. Though all the sequencers reviewed can convert to and from Type 1 Standard MIDI format, not all kept every piece of musical data intact in the process.

All of the programs except for *Balade* let you link several MIDI files into one. This ability provides a useful way to avoid annoying pauses in a multimedia presentation. With all of your music in one file, you can use Multimedia Extensions for Microsoft Windows' ability to play a preloaded file from any point.

### GETTING THAT SOUND

The electronic-sounding "trumpet" patch of an FM synthesis card bears little resemblance to the true trumpet sound of a ROM sample module. Even two very similar patches may have different attacks, decays, and volumes. As a result, simply matching patch names—which is all that General MIDI can do—often isn't enough for a sequence to sound its best on your MIDI hardware.

A good sequencer lets you experiment interactively with different patches and volume levels for each

track as your sequence plays. Since different instruments often sound best in different registers, you may have to raise or lower a track an octave or two when you change its patch.

Your choice of instrumentation can also help create variety (or unity) between songs during a multimedia presentation. Sometimes, you may want to create a richer sound by doubling parts—copying a track and assigning it a new patch so that the same music is played by two instruments at once.

Many sequences are created for monaural (monophonic) synthesizers, which can't separate their audio output into two channels (one for each speaker). If your sequence was created for a monaural synthesizer and you want to take advantage of the stereo capabilities found in many sound cards and modules, you'll need to add panning controllers to position each instrument sound in the stereo sound field.

### MANAGING TRACKS

Being able to copy tracks lets you save various versions of your music on different tracks and then compare them. It also lets you convert a conventional sequence to the Extended/Base Multitrack format recommended by the MPC spec. Muting different tracks during playback helps you figure out which tracks contain particular sounds. It's also useful in converting a sequence written for an extended synthesizer to play back on a base synthesizer. You're likely to find that you don't have enough polyphonic notes available to play all of the parts, and muting is the best way to determine which tracks are least essential.

### WORKING WITH SECTIONS

To fit a song to a particular time frame within a multimedia application, you can shorten or lengthen it by cutting out or repeating sections. The programs reviewed here let you easily cut and paste a section of music on either a single track or all tracks at once.

### TEMPOS AND TIMING

Many musical compositions will sound good at slightly different tempos. You may sometimes want to alter the tempo to suit your taste or to change the mood of the music; it's also a good way to fit a piece of music within a given time frame, if you need to alter its length slightly.

Some sequencers will adjust tempos to fit the music to a duration you specify. For coordination with multimedia, it's also important that a sequencer show positions in a sequence in minutes and seconds, as well as measures and beats.

### RITARDS AND ACCELERANDOS

Most sequencers can gradually increase and decrease the tempo in part of your sequence if you specify a start and end tempo. The changes are known as accelerandos and ritards, respectively. Some sequence libraries contain no tempo changes, making the music sound rather wooden. While in most cases it takes musical training to apply these effectively, anyone should be able to add a ritard at the end of a piece.

### FADE-INS AND FADE-OUTS

To begin and end songs, fading in and out can be especially effective if used in conjunction with graphics fades and wipes in a multimedia application. If you want to curtail a song after a given number of seconds, creating a fade-out is the simplest way to do so. You might also want to fade the volume down when a speech file is played, and fade the volume back up again when it's finished.

### WORKING WITH INDIVIDUAL NOTES

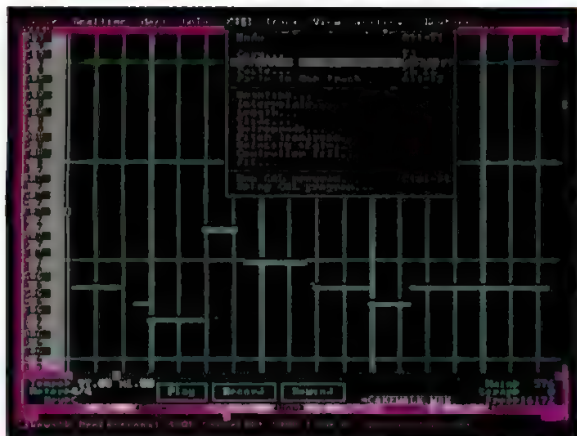
Although a sequencer's note editor is most valuable for composers who can use it to create and revise music—just as a writer uses a word processor—it may also prove essential to nonmusicians, though for different reasons. It's useful, for example, in determining the boundaries of musical sections, which don't always begin and end at the bar line, and it also comes in handy for adding special effects, such as the applause or bird songs found in some sound generators. ■





## MULTIMEDIA

### MIDI Software



**Cakewalk Professional's piano-roll note editor makes it easy to follow your music. Pull-down menus and scroll bars give a GUI feel to this text-mode program.**

our November 29, 1988, issue.

*Cakewalk Professional's* text-mode interface emulates a GUI by providing full mouse support, pull-down menus, dialog boxes, and even scroll bars. It may not be Microsoft Windows, but it does make the program simple to work with. Speed-key alternatives supplement the menu options.

The program successfully imported all of the elements of our MIDI test file. Unlike most other packages, though, *Cakewalk Professional* didn't place the imported program numbers and channel assignments for each track on the main screen where they could be easily viewed and changed.

Fortunately, it attached the channel numbers to each individual note, letting you override them with new settings on the main screen. The program numbers, however, could only be viewed and altered from *Cakewalk Professional's* event list editor where they overrode any program numbers entered on the main screen.

During playback, the main screen lets you change any of its track settings, which include transposition and volume (controlled by scaling all key velocities on the fly). Function-key combinations toggle you among this screen, the measures screen, and the note editors during playback.

In the measures screen, you can select blocks for editing on any clock pulse, though it's a little awkward to select material on several tracks at once. A unique feature also lets you select blocks by ear: While the piece is playing, you press keys to define the beginning and end of

the section. You can also save and recall selection ranges, which is useful for keeping track of sections in your music.

*Cakewalk Professional* makes it very easy to create ritards and accelerandos, as well as crescendos and diminuendos, by either scaling key velocities or inserting Controller 7 messages. Musicians will love the other tremendously powerful global-editing features, which surpass those of any competitor and give you extensive control over almost any type of MIDI

event. A cyclic undo lets you switch back and forth between the new and original versions and play each back for comparison.

#### TEMPO HANDLING

When it comes to handling tempos, the program isn't quite as adept. You can change the starting tempo during playback, but the only way to scale all tempos in a song proportionally is by means of a Fit-to-Time feature. This adjusts the song to the duration you specify in minutes and seconds; it can require a good deal of trial and error to achieve the tempo you want. On the other hand, this feature, along with the status indicator displaying minutes and seconds during playback and editing, can be quite useful for coordinating your music with a presentation.

*Cakewalk Professional* displays tempo changes in an event list editor, where you can easily alter them. A separate event list displays continuous controllers, aftertouch, pitch bend, and notes. But there is no way to line these elements up against the notes in the piano-roll note editor to view them in a musical context.

As your music plays, following it from the piano-roll note editor is made easy by a moving cursor. You can zoom in and out during playback, and a step playback feature lets you play one note at a time.

Inserting and deleting notes, dragging them to new positions, and changing their durations or key velocities is also straightforward and intuitive.

If you need to work with Type 0 MIDI files, *Cakewalk Professional* will split the single track into new tracks for each channel, but only one channel at a time. It can also load a MIDI file from disk and tack it onto the sequence on-screen, though it strips all tempos from the new file.

*Cakewalk Professional* has a full complement of recording features, including a versatile step record and punch in. Quantization is also very flexible. If you want to augment the substantial features built into the package, *Cakewalk Professional* not only lets you store keystroke macros, it also provides a very powerful—though somewhat arcane—script language. For serious musicians, there's support for SMPTE (Society of Motion Picture and Television Engineers) and MIDI Time Code synchronization with tape, and the program will download and upload system-exclusive data.

*Cakewalk Professional* supports a wide range of MIDI interfaces, but the only MPC card among these is the Sound Blaster Pro. *Cakewalk Professional's* Sound Blaster driver uses a General MIDI patch layout and supports the board only in mono mode, but a stereo driver is forthcoming.

If you don't need features such as the script language, macros, and SMPTE support, *Cakewalk Professional's* low-

end counterpart, *Cakewalk*, is available for \$150. This version, however, also lacks the ability to scale all tempos proportionally and it won't run in 43-line or 50-line display modes to get more of your music on-screen at once.

The \$199 *Cakewalk Apprentice MIDI Starter Kit* contains a scaled-down *Cakewalk* and a Music Quest MIDI interface board. There's also the \$29.95 *Romeo Music Cakewalk Series*, which is a library of over 60 well-performed sequences in the *Cakewalk* format ranging from classical music to jazz.

A forthcoming version of *Cakewalk Professional* for Windows 3.1 should eliminate most of the program's current

Cakewalk's  
text-mode interface  
simulates a  
GUI by providing full  
mouse and  
menu support.



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| Xtreme Gold v2.5                           | 92   |
| After Dark for Windows                     | 27   |
| VirusSafe 4.5                              | 49   |
| AmiPro v2.0                                | 289  |
| AmiPro Pro Upgrade (special price)         | 89   |
| Displaywrite v5.0                          | 229  |
| AmiPro and 1 2 3 for Windows Upgrade       | 139  |
| Multimate v4.0                             | 259  |
| Professional Write Plus for Windows        | 163  |
| WordWriter Pro (new)                       | 59   |
| Word for Word Pro                          | 79   |
| WordPerfect v5.1                           | 249  |
| Wordstar v6.0                              | 214  |
| Grammarik IV                               | 54   |
| Grammarik for Windows                      | 54   |
| Microsoft Word v5.5                        | 204  |
| Microsoft Word for Windows v2.0            | 290  |
| Saiko Pers ColorPaint PS Printer           | Call |
| Sharp JX 320 Color scanner w/soft includes |      |
| AT interface/Image-in Software             | 1699 |
| PS/2 interface and Image-in Software       | 1789 |
| Sharp Notebook Computer 20MHz 386 SX 2     |      |
| meg ram 40 meg hd 10" paper white LCD      |      |
| 4 512b w/ MS DOS 5.0 and Laplink III       | 1699 |

**Spreadsheets**

|                       |     |
|-----------------------|-----|
| Canon Bubble Jet 10ex | 325 |
| Canon Bubble Jet 300  | 459 |
| Panasonic KX P1180i   | 160 |
| Panasonic KX P1124i   | 299 |
| Panasonic KX P2624    | 469 |

**Utilities**

|                                           |     |
|-------------------------------------------|-----|
| Spinnite                                  | 63  |
| Above Utilities for Windows 3             | 59  |
| Autimenu                                  | 35  |
| Carbon Copy Plus                          | 113 |
| Centra: Point Anti-Virus (special price)  | 79  |
| Centra: Point Backup v7.0                 | 79  |
| Check v3.0                                | 88  |
| Copy 1 PC v6.0                            | 29  |
| Direct Access v5.1                        | 62  |
| Disk Technician Gold                      | 95  |
| Fastback+ v3.0                            | 65  |
| Staracer (special price)                  | 79  |
| Netraiser                                 | 54  |
| Menu Works                                | 25  |
| Norton Utilities v6.01                    | 109 |
| Norton Backup v1.2                        | 89  |
| Norton Commander v2.0                     | 97  |
| Norton Desktop for Windows                | 96  |
| PC Tools Deluxe v7.1                      | 102 |
| PC Tools Deluxe 7.1+ Anti-Virus (special) | 149 |
| Print Cache                               | 104 |
| Q DOS III                                 | 45  |
| QEMM 386 v6.0 (special price)             | 60  |
| GRAM                                      | 79  |
| PrintQ 5.0                                | 79  |
| Virex PC v2.0                             | 75  |
| Windows Express                           | 54  |
| Xtreme Gold v2.5                          | 92  |
| After Dark for Windows                    | 27  |
| VirusSafe 4.5                             | 49  |

**Word Processing**

|                                      |     |
|--------------------------------------|-----|
| AmiPro v2.0                          | 289 |
| AmiPro Pro Upgrade (special price)   | 89  |
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| Grammarik IV                         | 54  |
| Grammarik for Windows                | 54  |
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| Microsoft Word for Windows v2.0      | 290 |

**Specials**

|                                            |      |
|--------------------------------------------|------|
| Saiko Pers ColorPaint PS Printer           | Call |
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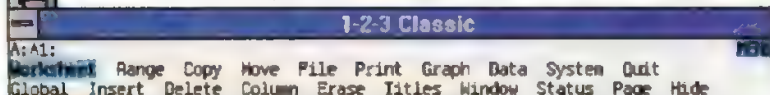


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Click the SmartSum icon to add up columns and rows. Even if the totals are separated by blanks or dotted lines.

$$\begin{array}{r} 1 \\ + 2 \\ \hline 3 \end{array}$$

The 1-2-3 Classic\* menu helps make the move from DOS to Windows a smooth one. Just press the slash key and the familiar 1-2-3 menu appears, fully-functional, on screen.



| Operating Revenue | Qtr 1     | Qtr 2     | Qtr 3     | Qtr 4     | Total      |
|-------------------|-----------|-----------|-----------|-----------|------------|
| Qtr 1             | 1,000,000 | 1,200,000 | 1,500,000 | 1,800,000 | 5,500,000  |
| Qtr 2             | 1,200,000 | 1,500,000 | 1,800,000 | 2,000,000 | 6,500,000  |
| Qtr 3             | 1,500,000 | 1,800,000 | 2,000,000 | 2,200,000 | 7,500,000  |
| Qtr 4             | 1,800,000 | 2,000,000 | 2,200,000 | 2,500,000 | 8,500,000  |
| Total             | 5,500,000 | 6,500,000 | 7,500,000 | 8,500,000 | 28,000,000 |

Only with the true 3D capabilities of 1-2-3 can you consolidate related spreadsheets into one file without needing to go through the process of file-linking.



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# Some little about a well-kno

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Consider 1-2-3 for Windows.™ Which has innovations that other spreadsheets, such as Microsoft® Excel, don't have.

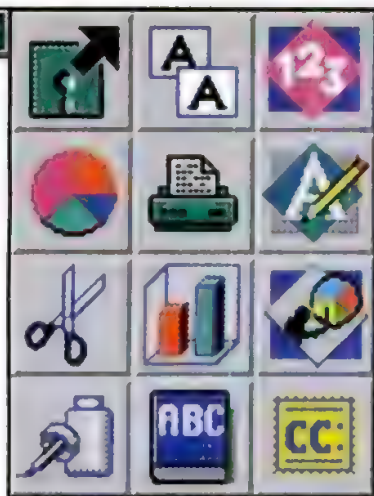
Such as the ability to center text over multiple columns. Dialog boxes that give you the

option of selecting a range before a function or a function before a range. The Solver technology that not only finds the optimal answer, but also provides alternatives that meet your constraints. The capacity to integrate data from a variety of dissimilar databases.

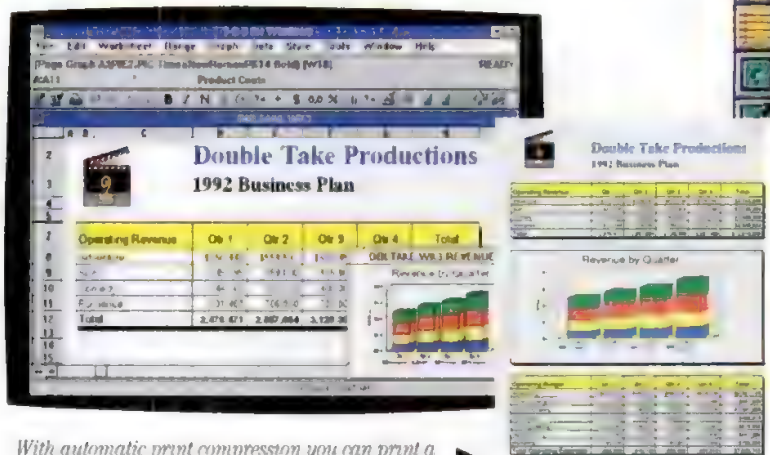
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Plus, we've recently updated the product to include file compatibility with Microsoft





Only 1-2-3 for Windows offers SmartIcons™—our customizable icon palette—for one-click access to your most frequent tasks. And unlike the Toolbar™ in Microsoft® Excel, only 1-2-3 for Windows lets you create your own unique icons and place them anywhere on the screen.



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With other spreadsheets, you have to paste clipboard data on your next step or you'll lose it. With 1-2-3 for Windows, it remains available to paste until your next edit.



# known facts wn spreadsheet.

Excel 3.0, as well as enhancements to its overall performance and speed.\* Now if all this is news to you, there's more. Because right now you can upgrade from your current version of 1-2-3 to 1-2-3 for Windows and get both 1-2-3

and Ami Pro™ 2.0, our award-winning word processor for Windows, for just \$279.\*\* A suggested retail value of \$645. For a free auto demo or to order your upgrade directly from Lotus,\*\* call 1-800-TRADEUP, ext. 6523.

## 1-2-3 for Windows



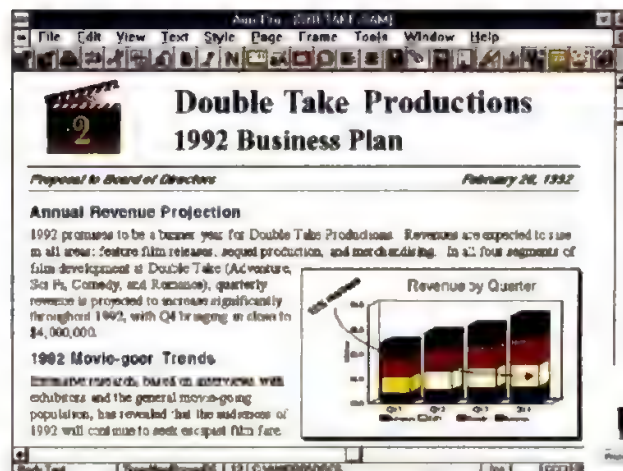
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Body Text

TimesNewRomanPS

12

# "Ami Pro 2.0 stands un powerful and enjoyable

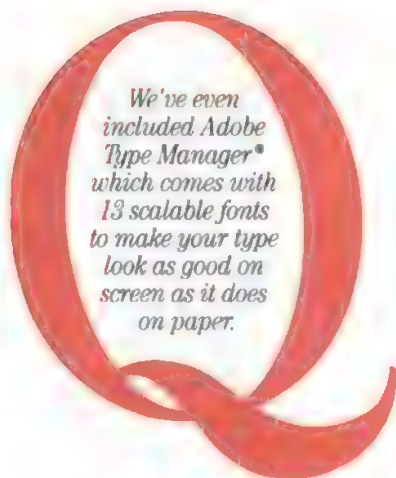
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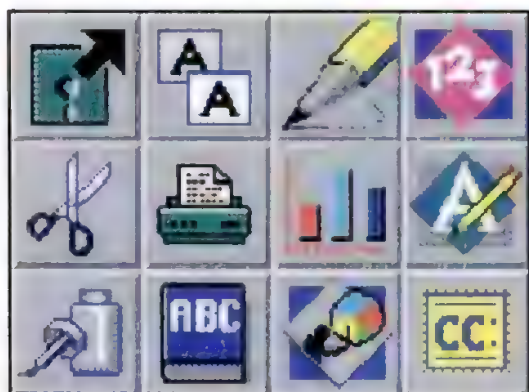
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# challenged as the most Windows word processor."

—PC Magazine 11/12/91

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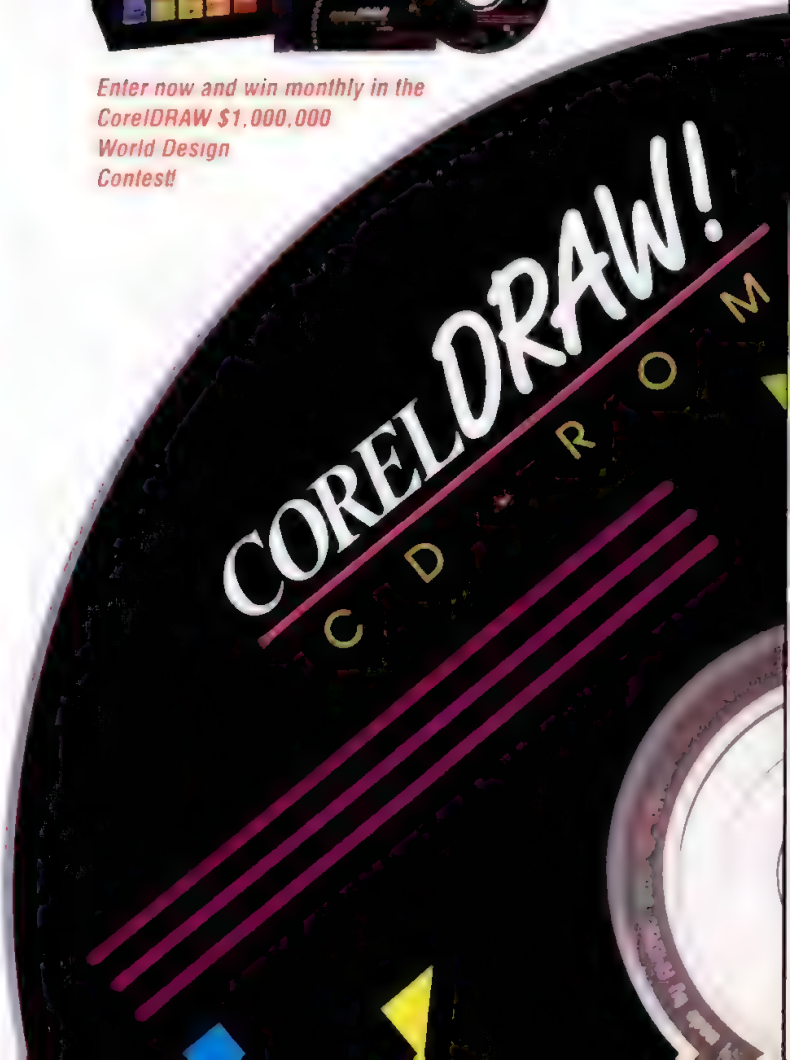
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## MIDISOFT STUDIO COMES TO WINDOWS

by Robert Kendall

*Master Tracks Pro* won't be the only Microsoft Windows sequencer on the block for much longer. At review time, Midisoft Corp. was putting the finishing touches on *Midisoft Studio for Windows*, so we looked at a prerelease version. This \$249.95 package doesn't have the muscle of *Master Tracks Pro*, but it will provide a less-expensive Windows alternative.

*Midisoft Studio for Windows* offers the most important editing functions wrapped in an attractive, easy-to-use interface. The program differs most obviously from its high-end competitors in the editing views it provides.

It lacks the usual piano-roll note editor and the measures screen, substituting conventional musical notation for both. Though this is much less useful for nonmusicians, the program makes the music easier to follow than most notation displays by highlighting each note in green as it sounds.

One advantage of conventional notation is its ability to let you see the notes on all tracks at once—a feat impossible with the piano-roll editors in the other sequencers reviewed here. From this window you can also cut-and-paste between tracks or select sections for global editing across several tracks. Selecting or moving large blocks with the mouse can be awkward, though, since it involves a lot of scrolling. It's usually easier to perform these functions by typing in measure numbers.

The program's main window gives you interactive control during playback over the same track parameters as *Master Tracks Pro*—program number, volume (Controller 7), and channel—while letting you transpose and scale key velocity on the fly. There's also a handy graphical meter for each track that shows key velocity during playback.

As in *Master Tracks Pro*, a slider will scale all tempos proportionally as your sequence plays. This feature is especially useful here because the adjusted tempos are exported with your MIDI file and are not merely temporary. For controlling playback and recording, you can click on tape recorder controls.

An event list editor lets you view and edit controllers, aftertouch, pitch bend, and program numbers, as well as

is a liability for anyone who wants to hear exactly what his sequence will sound like when played by another Windows application.

Multimedia authors will miss having a position indicator that shows minutes and seconds. Professional musicians will miss features such as support for MIDI Time Code and SMPTE synchronization with tape.

Midisoft is releasing the first version of *Studio for Windows* as Version 3.0, for consistency with *Midisoft Studio Advanced*, the low-end sequencer it currently has on the market. This \$99.95 GEM product, however, bears little relationship to the Windows package.

In order to make *Midisoft Studio for Windows* available as quickly as possible, the company is taking the unusual step of releasing an incomplete first version of the package. Some features will be listed in the menus and documentation but won't be implemented in the program. A free upgrade to Version 3.1 will give you these missing features, which include Undo, Step Playback (for playing back sequences one note at

a time), and Punch In/Out. Selecting patches by instrument name will also be possible with Version 3.1.

*Midisoft Studio for Windows* doesn't have all the power or flexibility of some other packages in the same price range, but its functionality and intelligent interface will make it a welcome addition to the Windows domain. ■

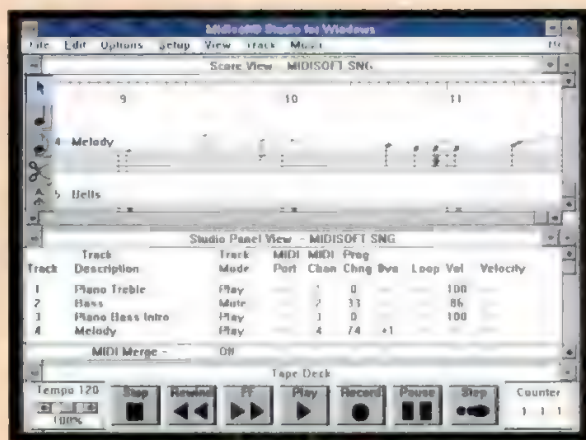
### **Midisoft Studio for Windows, Version 3.0**

Midisoft Corp., P.O. Box 1000, Bellevue, WA 98009; 800-776-6434, 206-881-7176.

**List Price:** \$249.95; with MIDI interface card, \$349.95.

**Requires:** 1MB RAM (2MB recommended), DOS 3.0 or later, Microsoft Windows 3.0 or later.

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**Midisoft Studio for Windows uses conventional musical notation to display your music. Notes selected for editing appear in red.**

notes. There's a separate event list for tempo changes. Unfortunately, you can't align these elements visually with the music in the notation window to make them easier to work with.

*Midisoft Studio for Windows'* global-editing functions are very limited. You can create ritards and accelerandos or crescendos and decrescendos using key velocity. You can't, however, globally edit continuous controllers (such as Controller 7 for volume), note durations, or most other event types.

Other features include step recording and quantization. The program supports the full range of MPC audio boards through Multimedia Extensions for Microsoft Windows, yet it can't use the Windows MIDI Mapper. This



weaknesses. It will also let you edit controllers by either drawing curves or moving sliders during playback, and will add a conventional musical notation window.

## Master Tracks Pro

Passport Designs is a significant presence in the MIDI industry, both as a veteran of software for musicians and as the principal architect of General MIDI. The company's superb \$395 flagship product, *Master Tracks Pro*, Version 3.97, was the only Microsoft Windows sequencer on the market at the time of this evaluation.

This powerful program fully supports the MIDI capability of Multimedia Extensions for Microsoft Windows, letting you access the MIDI hardware either directly or through the Microsoft Windows MIDI Mapper. You can switch freely between *Master Tracks Pro* and other Windows applications that use MIDI, though you must close and then reopen the MIDI port via a dialog box every time you leave and then return to the sequencer.

*Master Tracks Pro* makes excellent use of the graphical environment, offering a consistent and easy-to-use interface that lets you open different views of your

## MULTIMEDIA MIDI Software

sequence simultaneously. You can have the piano-roll note editor in one window, a tempo map in a second window, and your track names and settings in a third window.

From the main window, you have interactive control over muting, patch, and volume for each track. On-screen sliders that you can move with the mouse provide the most elegant means available for setting track volumes.

Interactive control over volume is available only through Controller 7. If your synthesizer doesn't respond to this controller, or a track already contains Controller 7 messages (which will cancel out the setting from the main screen), you'll have to change volume by scaling key velocities from the global-editing menu.

You can select patches by instrument name rather than just program number, saving you from constant reference to your synthesizer's manual. Patch layout templates are provided for General MIDI and eight popular synthesizers, including the MT-32.

Cutting and pasting is easier in *Master Tracks Pro* than in other sequencers. From the main window, you can drag entire tracks to new positions, or even drag settings from one track to another. In the measures window, you can select and move multitrack blocks as simply as you can move text in a Windows word processor.

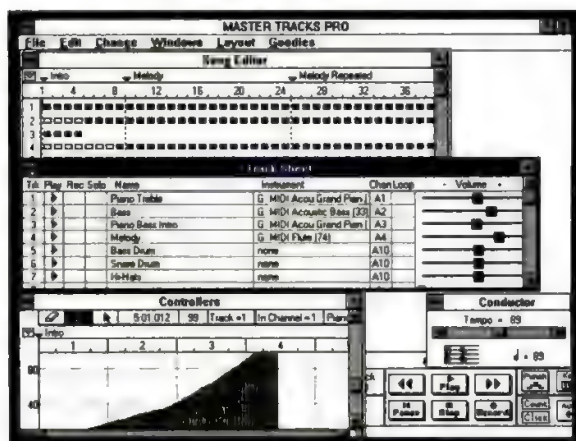
Global-editing options, such as transposition and changing note durations, are straightforward, yet flexible. A cyclic undo for most global changes lets you switch back and forth between your new and old versions and compare the sounds of each.

The piano-roll note editor makes it easy to follow your music during playback by giving you a moving cursor and letting you zoom in and out. Editing individual notes, however, is harder than in *Cakewalk Professional* or *Sequencer Plus Gold*. The small size of the notes and the lack of a snap-to-grid feature necessitate some real precision mouse work.

*Master Tracks Pro* puts its graphical interface to good use in the tempo win-

dow, which presents an editable line graph representing tempo changes. You can create ritards and accelerandos for a selected section by specifying starting and ending tempos. An on-screen slider lets you proportionally scale all the tempos in the piece during playback, but a separate global-editing operation is required to make them permanent.

Another GUI advantage becomes apparent in editing continuous controllers, pitch bend, and aftertouch. You view



*Master Tracks Pro* lets you display different aspects of your sequence in different windows. You can control volume by moving sliders with the mouse or by drawing a curve in the Controllers Window.



### Master Tracks Pro, Version 3.97

Passport Designs Inc., 100 Stone Pine Rd., Half Moon Bay, CA 94019; 415-726-0280.

List Price: *Master Tracks Pro*, \$395; Trax, \$99.

Requires: 640K RAM (2MB recommended), MIDI interface, DOS 3.1 or later, Microsoft Windows 3.0 or Multimedia Extensions for Microsoft Windows 1.0.

In Short: *Master Tracks Pro's* innovative use of the Microsoft Windows interface makes it the most intuitive sequencer for serious musicians and amateurs alike. It gives you easy control over nearly every aspect of your sequence.

CIRCLE 488 ON READER SERVICE CARD

and edit these events as bars in a graph with the vertical axis depicting their values. Dragging the cursor along a curve adds a graduated series of events, such as a crescendo. Unfortunately, this is also the only means of editing program numbers that may be embedded at various points after the beginning of a sequence. Since the graph's grid doesn't show single increments, this display makes it almost impossible to determine their exact values.

Another innovative feature lets you create crescendos or decrescendos interactively while your sequence is playing. Just move the volume slider for a track, and the volume changes you hear will be embedded in the track as Controller 7 messages. You can alter only one track at a time, but you can easily copy the controllers into other tracks to fade the entire song in or out.

### COORDINATING MUSIC AND GRAPHICS

Multimedia authors attempting to coordinate their music with graphics in a presentation will find some useful aids. A status



My Dearest Ellen,

If there is anything better than being loved by you...it is loving you.

And you are so easy to love. You've brought such wonder into my life and have touched my heart with your love.

I just want you to know, my darling, that it feels so good being in love with you and I want to love you for a very long time.

You are a wonderful woman and I love you dearly. If I'm dreaming, please don't wake me up--I don't want this to end.

Yours monogamously

1040 U.S. Individual Income Tax Return

Label

Line 1040

U.S. Individual Income Tax Return

For the year 1991

Label

Line 1040

U.S. Individual Income Tax Return

For the year 1991

F1 - Help! F3 - Options

To: Chris Keenan  
From: Scott Anderson  
Subject: Career-Limiting Remarks  
Date: 10/07/91

During a recent dinner at Chairman Binkelheimer's home, you stated that members of the Daughters of the American Revolution are "a bunch of old battle-worn."

Judging from the fact that you made this comment within earshot of the Chairman, you must not be aware that Mrs. B. is a founding member of the local D.A.R. chapter and holds rank of Brigadier General.

Microsoft Word EVALUATE.DOC

File Edit View Insert Format Utilities Macro Window Help

EMPLOYEE EVALUATION

EMPLOYEE NAME

RESUME

EMPLOYEE NAME

RESUME

EVALUATION COVER

PERFORMANCE OF

CHARACTER ISSUE

OTHER COMMENTS

RE COMMENDATIONS

I got a new job,  
LET'S PARTY!

Date: November 3

Time: 8PM

Place: Lyle's Place

123 Unemployment Lane

555-1212

RSVP

And remember, don't  
tell anyone else at  
the office!!!

# Your PC can say a lot about you.

If somebody sat down at your PC and started snooping around your disk, which would embarrass you more?

The details of your love life? Your resume? Your adjusted gross income?

How about the Confidential Employee Evaluation you were working on when the Boss hauled you into his office for a chat?

What? You never thought about this before? Then read on and you'll never have to think about it again.

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That's the key to DiskLock,™ the painless, yet powerful, Windows-compatible way to keep other people's noses permanently out of both your personal and professional data.

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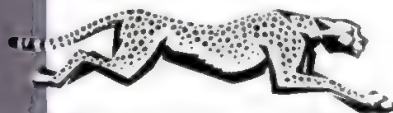
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CIRCLE 284 ON READER SERVICE CARD



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CIRCLE 108 ON READER SERVICE CARD



### SUMMARY OF FEATURES

Products listed in alphabetical order



|                                                        | Ballade                             | Cakewalk Professional                                                                                      | Master Tracks Pro                                                                                                                              | Prism                               | Sequencer Plus Gold                                                                                                                                                                                 |
|--------------------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| List price                                             | \$195.00                            | \$249.00                                                                                                   | \$395.00                                                                                                                                       | \$99.00                             | \$299.95                                                                                                                                                                                            |
| <b>GENERAL FEATURES</b>                                |                                     |                                                                                                            |                                                                                                                                                |                                     |                                                                                                                                                                                                     |
| Maximum number of tracks                               | 10                                  | 256                                                                                                        | 64                                                                                                                                             | 16                                  | 2,000                                                                                                                                                                                               |
| Maximum note capacity                                  | 20,000                              | 40,000                                                                                                     | Unlimited                                                                                                                                      | 15,000                              | 50,000                                                                                                                                                                                              |
| Resolution<br>(clock pulses per quarter note)          | 48                                  | 48-480                                                                                                     | 240                                                                                                                                            | 96                                  | 96 or 192                                                                                                                                                                                           |
| Interface                                              | Proprietary GUI                     | Text mode                                                                                                  | Microsoft Windows                                                                                                                              | Proprietary GUI                     | Text mode                                                                                                                                                                                           |
| MIDI interfaces supported                              | MPU-401                             | AdLib, CMS, KEE MIDIator, MIDI Time Piece, MPU-401, Music Quest MQX Series, PS/1, Sound Blaster, Yamaha C1 | Microsoft Windows with Multimedia Extensions, Miracle Piano Teaching System, MPU-401, Music Quest MQX Series, Pro AudioSpectrum, Sound Blaster | MPU-401, Yamaha C1                  | AdLib, ATI, CompuAdd, Covox MIDI Maestro, Covox Sound Master, IBM Music Feature, MPU-401, Music Quest MQX Series, PAIA PCM 68, Pro AudioSpectrum, Sound Blaster, Tecmar Level 1, Voyetra, Yamaha C1 |
| <b>PLAYBACK</b>                                        |                                     |                                                                                                            |                                                                                                                                                |                                     |                                                                                                                                                                                                     |
| Step playback                                          | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input type="checkbox"/>                                                                                                                       | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Changes allowed before/during playback:                |                                     |                                                                                                            |                                                                                                                                                |                                     |                                                                                                                                                                                                     |
| Track muting                                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Patch number                                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| MIDI channel                                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Volume (Controller 7)                                  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Scaling of all key velocities                          | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input type="checkbox"/>                                                                                                                       | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Transposition                                          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input type="checkbox"/>                                                                                                                       | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Tempo                                                  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Panning                                                | <input checked="" type="checkbox"/> | <input type="checkbox"/>                                                                                   | <input type="checkbox"/>                                                                                                                       | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| <b>NOTE EDITOR</b>                                     |                                     |                                                                                                            |                                                                                                                                                |                                     |                                                                                                                                                                                                     |
| Piano-roll note editor                                 | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Number of octaves displayed simultaneously in VGA mode | N/A                                 | 3.5                                                                                                        | 8                                                                                                                                              | N/A                                 | 3                                                                                                                                                                                                   |
| Conventional music notation                            | <input checked="" type="checkbox"/> | <input type="checkbox"/>                                                                                   | <input type="checkbox"/>                                                                                                                       | <input type="checkbox"/>            | <input type="checkbox"/>                                                                                                                                                                            |
| Event list                                             | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input type="checkbox"/>                                                                                                                       | <input checked="" type="checkbox"/> | <input type="checkbox"/>                                                                                                                                                                            |
| <b>EDITING</b>                                         |                                     |                                                                                                            |                                                                                                                                                |                                     |                                                                                                                                                                                                     |
| Crescendo and decrescendo                              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Accelerando and ritardando                             | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Quantization                                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Changes note durations globally                        | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Edits any controller                                   | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Undo feature                                           | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input checked="" type="checkbox"/> | <input type="checkbox"/>                                                                                                                                                                            |
| Step record                                            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Markers                                                | <input type="checkbox"/>            | <input type="checkbox"/>                                                                                   | <input checked="" type="checkbox"/>                                                                                                            | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Patch selection by instrument name                     | <input checked="" type="checkbox"/> | <input type="checkbox"/>                                                                                   | <input checked="" type="checkbox"/>                                                                                                            | <input type="checkbox"/>            | <input type="checkbox"/>                                                                                                                                                                            |
| Sends and receives system-exclusive data               | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |
| Shows position in seconds                              | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                        | <input checked="" type="checkbox"/>                                                                                                            | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                                                                                                                                                 |

N/A—Not applicable: The product does not have this feature.





## MULTIMEDIA

### MIDI Software

indicator shows the current cursor position in minutes and seconds. If a sequence doesn't quite fit a time slot in a presentation, you can specify a duration and the program will scale all tempos to make the song fit.

You can position markers by specifying a time in seconds and they will stay in position regardless of any alterations to the music, letting you use them as reference points for graphical events in a presentation. *Master Tracks Pro* is also the only program that can import and export markers in Standard MIDI Files—a very useful feature if you want to work with Passport's large library of MIDI files, which contain markers to delineate musical sections.

#### FLEXIBLE RECORDING OPTIONS

*Master Tracks Pro's* recording options are flexible, easy to use, and include Punch In and one of the most intuitive step record features on the market. The package can't match the advanced global-editing features of *Cakewalk Professional* or *Sequencer Plus Gold*, but it does support MIDI Time Code and SMPTE synchronization for performers who want to work with tape.

Despite a few shortcomings, *Master Tracks Pro* gives you more intuitive control over all elements of your sequence than any competitor. By the time you read this, an upgrade should be available that will let you precisely edit program numbers anywhere within the sequence, making the note editor easier to use. It will also provide an event list editor, a replacement for the currently inadequate manual, and the ability to open several sequences at once.

A scaled-down version of *Master Tracks Pro*, called *Trax*, offers most of the features useful to nonmusicians for \$99. It is, however, very limited in viewing and editing continuous controllers, won't display tempo changes, and can't fit a song to a duration by adjusting tempos.

## Prism

*Prism*, Version 1.5, is an inexpensive package from Dr. T's Music Software that takes a unique approach to many aspects of sequencing. Though this \$99 program has many limitations, it also has some capabilities not found in any of the other products reviewed here.



#### Prism, Version 1.5

Dr. T's Music Software Inc., 124 Crescent Rd., Needham, MA 02194; 800-989-6434, 617-455-1454.

List Price: \$99.

Requires: 512K RAM, MIDI interface, DOS 3.0 or later.

In Short: *Prism* offers some very powerful global-editing options in an inexpensive DOS package, but it is seriously hampered by its limited basic capabilities.

CIRCLE 488 ON READER SERVICE CARD

*Prism* runs as a DOS application using its own graphical interface. It offers separate windows for each editing screen, which you can reposition, resize, overlap, or minimize. Microsoft Windows users will find other familiar elements, though not with the smoothness they're used to.

Unlike other sequencers, *Prism* is pattern-based. It lets you create sections of music called patterns, and then list pattern names in the order you want them played. Since you can edit patterns and the play list independently, this saves a lot of work for musicians writing pop songs with many repeated sections.

For multimedia authors, it can provide an easy way to link MIDI files to save file-loading time during a presentation: just import each MIDI file to a different pattern and then export the entire song. The drawback is that all of the sequences are set to the same tempo. If you have no use for the pattern feature, you can ignore it and work entirely within one pattern.

The program shows track names, channel numbers, and muting status beside each track in the measures window. Tempo appears in

another window, and muting in combination with tempo are the only parameters you can change during playback.

Unlike other sequencers, *Prism* shows each beat of every track, rather than each measure, as a box in the measures windows. This makes for more precise cutting and pasting but limits the number of measures you can view simultaneously to four. If a note begins in one measure and is sustained through the next, the second measure is displayed as empty.

You can select blocks by clicking and dragging, but there are some annoying limitations to cutting and pasting. For example, if you delete a section in the middle of a song, *Prism* won't close up the hole by shifting the succeeding music forward. Another liability is the program's limit of 16 tracks, which will let you import most sequences, but can be insufficient for storing alternative versions as you edit.

You can't select areas for global editing from the measures screen or start playback from the beginning of the selected area. The only way to change the starting point for playback is to click and hold down the fast forward or rewind buttons to move you—one beat at a time—to a new location.

An event list serves for editing individual notes, program numbers, and all controllers. This type of display is inherently unintuitive for viewing and editing individual notes. Rather than displaying a single note with a duration, it has an awkward note-on (start) and note-off (end) event for each note. The package also lacks the ability to scroll during playback. But the event list also allows global edit-



*Prism's* graphical interface lets you draw a curve to define the values for volume or other continuous controllers.

# Brad

always dreamed of owning a red slant nose 911 Turbo Cabriolet. Just like the one the exotic brunette was driving when she pulled up next to him at the red light.



# His

mouth went dry as he watched her caress the gear shift and rev the engine. She was toying with him, and he knew it.

**He**

wanted  
her more than the car. And  
then she slowly took off her  
sunglasses and said,





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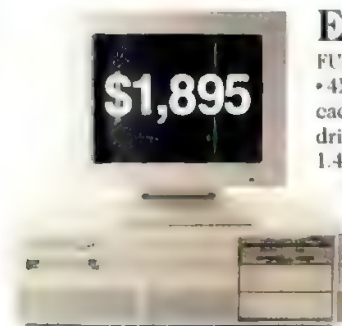
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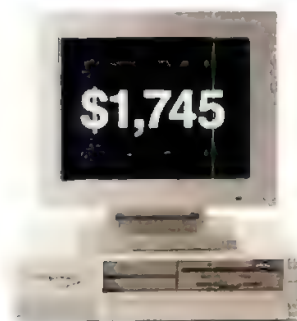


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# The

light turned green and then she was gone. Had Brad imagined the whole incident? If so, why did he have this sudden urge to call CompuAdd Express?

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## MULTIMEDIA

### MIDI Software

ing, which includes some surprisingly powerful options, though you can edit only one track at a time. A flexible but cumbersome event filter lets you select the controllers or other parameters, such as key velocity or pitch, that you may want to edit.

You can then scale the selected values up or down by typing in a number. The program's biggest strength, though, is its graph window. With it, you can define a curve for the values you've selected by positioning line nodes with the mouse. This is great for crescendos and decrescendos.

There's also a unique function for compressing or expanding the dynamic range of a song by drawing a line graph. Compressing makes the soft parts louder and the loud parts softer, which can be useful for music that will be played in a multimedia application: The user will be able to hear the quiet sections over the noise around him, yet the loud parts won't disrupt other people. Expanding is the reverse of compressing.

*Prism* is particularly weak in handling tempo. It doesn't allow tempo changes within a pattern, and when importing a MIDI file, it strips out all but the starting tempo. The only way to create a ritard is by shifting the note-on and note-off options in the event list so that they gradually become more widely spaced. This can be done as a global operation, but only one track at a time. Not only is this a cumbersome procedure, but the music will end up misaligned with the barlines, which can pose editing problems later.

Another element *Prism* strips from MIDI files upon import is track names, which can make it impossible to determine the correct instrumentation for a sequence. *Prism* offers some attractive global-editing features unmatched by other low-end packages. But its failure to let you move around easily in a sequence, view notes graphically, and import Standard MIDI Files intact makes it a poor alternative to *Cakewalk* or *Trax*, the low-end versions of *Cakewalk Professional* and *Master Tracks Pro*.

## Sequencer Plus Gold

*Sequencer Plus Gold* has been a prominent MIDI musician's tool for years, and although the software's manufacturer, Voyetra Technologies, does not yet have

a Microsoft Windows sequencer on the market, it is no stranger to multimedia. Voyetra provides many DOS multimedia applications vendors with APIs and drivers for MIDI hardware.

For MPC users, the \$299.95 *Sequencer Plus Gold*, Version 4.06, has an advantage over other DOS sequencers by supporting all of the MIDI synthesizer and interface boards you can use under Multimedia Extensions for Microsoft Windows. Voyetra's drivers for MPC FM synthesis boards emulate the General MIDI patches stored in the default Windows driver, but add a few enhancements such as support for stereo sound.

Over the years, this package has accumulated a host of impressive features, but it has retained a rather quirky user interface that many will find confusing. There are few tasks that *Sequencer Plus Gold* can't negotiate with aplomb, but there are often cryptic menus and unconventional keystroke assignments that make this program harder to master than most.

*Sequencer Plus Gold* performed our tests without a hitch. It lets you switch easily among different screens as your music plays, and provides easy, interactive control during playback of more track parameters than any other sequencer. Each track has a setting for not only initial patch, muting, and volume, but also transposition and panning.

During playback, you can control volume either by adjusting Controller 7 or by increasing or decreasing all key velocity values on the fly. This allows interactive volume control over any synthesizer. When you export your work as a MIDI file, the scaled key velocities and other track parameters are saved in the sequence.

### SIMPLE CUTTING AND PASTING

*Sequencer Plus Gold* makes cutting and pasting sections or whole tracks very simple. You can use the mouse to select multitrack blocks in the measures screen and drag them to new locations. Unfortunately, though, for cutting and pasting, you can only select blocks that begin on the first beat and end on the last beat of a bar.

This is the only program besides *Master Tracks Pro* that lets you add markers to your music for keeping track of section boundaries. Like *Master Tracks Pro*, *Sequencer Plus Gold* also lets you anchor markers to times in minutes and seconds,



### Sequencer Plus Gold, Version 4.06

Voyetra Technologies, 333 Fifth Ave., Pelham, NY 10803; 800-233-9377, 914-738-4500.

List Price: *Sequencer Plus Gold*, \$299.95; *Sequencer Plus Classic*, \$169.95; *Sequencer Plus Junior*, \$69.95.

Requires: 512K RAM (640K recommended), MIDI interface, DOS 2.0 or later.

In Short: *Sequencer Plus Gold* is a full-featured powerhouse that is harder to learn than its competitors. It is the only DOS sequencer that offers comprehensive support for MPC audio boards.

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so you can use them to see where other multimedia events will occur in relation to the music. A status indicator shows your current position in minutes and seconds.

*Sequencer Plus Gold* stores tempo changes on a separate tempo track. It even gives you the ability to create different tempo tracks and select the one you want to use for playback, making it easy to experiment. On the down side, when you add or delete any track of music, the active tempo track's number may change without your knowledge, and you'll have to reselect it.

Scaling all tempos in the tempo track by a selected ratio is no problem, but you must change the starting tempo as a separate step. During playback you can adjust only the starting tempo; you can't change it in the tempo track. You have lots of flexibility in generating ritards and accelerandos, or crescendos and diminuendos. You can control the rate of change as well as the starting and ending values; for example, a crescendo could start gradually and then build more and more rapidly.

The piano-roll note editor is harder to follow during playback than most. Although the screen scrolls, there is no cursor to indicate the current bar or beat. And it doesn't let you zoom in and out. In editing, each note sounds when you put the cursor on it, which is a big help in





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### MIDI Software

finding your place in the music. Pressing the Tab key moves the cursor to each note in succession and serves as step-by-step playback.

Editing individual notes is exceptionally easy, since dragging them with the left mouse button changes their position, while dragging with the right button changes their length. Non-note events—

such as continuous controllers, aftertouch, and tempo changes—appear under the notes in the step editor for easy viewing and editing.

One annoyance in importing Standard MIDI Files with *Sequencer Plus Gold* is that the new file is merged with the one already on-screen, unless you first remember to clear the sequence you're working with. On the other hand, this feature lets you link MIDI files, even if the sequences have different tempos and time signatures. Upon import, the program splits Type 0 Standard MIDI Files into multiple tracks by channel for easier editing.

#### ROBUST RECORDING OPTIONS

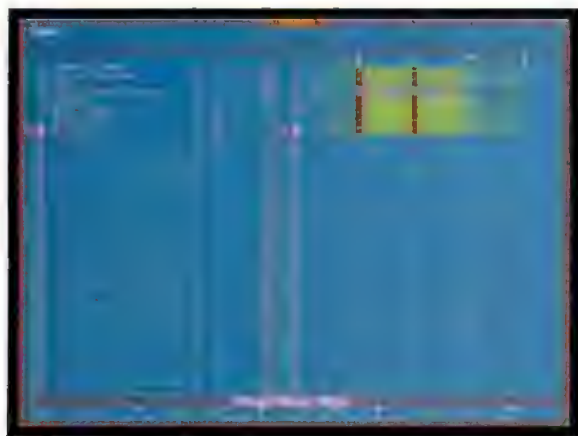
*Sequencer Plus Gold's* robust recording options make things easy for beginners while meeting the needs of professional musicians.

There are unusually powerful and flexible quantization features, including a *swing* option that nonmusicians could easily use to delay each upbeat slightly and give the music a jazzy lilt.

Musicians will also love the array of advanced global-editing features that allow formidable control over note pitches and durations, as well as continuous controllers. For performers, there is support for MIDI Time Code and SMPTE synchronization with tape. The technically adventurous will appreciate the patch editor for altering sound parameters stored in Voyetra's FM synthesis sound board drivers.

If you don't want to pay for features that are useful only to serious musicians, you should consider *Sequencer Plus Classic*, which, for \$169.95, offers nearly all of the features of value to nonmusicians. *Sequencer Plus Junior*, which is often bundled with packages from sound-board vendors, gives you only the basic functions for \$69.95.

*Robert Kendall is a New Jersey-based free-lance writer and frequent contributor to PC Magazine.*



In its Measures screen, *Sequencer Plus Gold* lets you use the mouse to define sections across multiple tracks for cutting and pasting or for global editing.

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## HAYES OPTIMA PANICS COMPETITION

by Gary Lancaster

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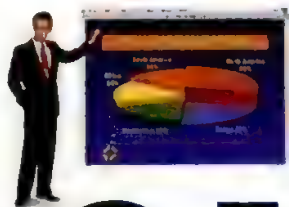
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## MULTIMEDIA

Microsoft Windows with Multimedia Extensions is making authoring easier. But progress is evolutionary. Our reviews of three multimedia-powered authoring tools show it's still tough going.

### AUTHORING SOFTWARE

# Author! Author!

by Alfred Poor

You can use a number of tools to create multimedia, but the most powerful of these are authoring systems. Multimedia authoring programs do two things really well. First, by supporting many hardware devices and many file formats, they let you build complex productions that combine graphics, text, sound, animation, and video elements. Second, but equally important, they provide a navi-





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### Authoring Software

gational framework for these elements, usually in the form of some sort of hyper-linking system.

Multimedia authoring software is not a new category of product. For years professionals have been using authoring software to create intricate educational, training, and sales presentations. But the learning curve to use these tools was enormous; each product was highly idiosyncratic, and each had its own narrow set of supported hardware. The last time we took a comparative look at multimedia authoring systems was in our July 1990 issue. We concluded that multimedia was not yet ready for the mainstream, and was best left in the domain of media professionals.

Today's multimedia authoring systems are still large applications—and still require serious training—but they are considerably more manageable than be-

fore. As multimedia becomes a part of our day-to-day work environment, these packages will play an increasingly important role.

The arrival of Microsoft Windows 3.0 in May 1990 certainly helped make authoring systems more consistent. In addition to its graphical user interface and its "shared peripherals" environment, this version provides significant advances in memory management.

A more recent Windows enhancement, the add-on Multimedia Extensions, speaks directly to the needs of multimedia developers by offering a standard way to include sound and movement in PC applications. Later this year, we expect to see the introduction of Windows 3.1, which incorporates some of the components of Multimedia Extensions.

### THE IMPORTANCE OF EXTENSIONS

The importance of Multimedia Extensions cannot be underestimated. This tool allows Windows to overcome one of the biggest headaches in multimedia: hardware compatibility. It works directly with multimedia hardware: CD-ROM drives, audio devices, and more.

To help you understand the power of this feature, we should say a word about how Windows works with displays. In terms of graphics adapters and monitors, Windows is said to be *device-independent*, which means that it is not limited to supporting a certain set of video components. Instead, it is designed to interact with a separate Windows video adapter driver. This means that when a computer company builds a new type of graphics adapter card, the manufacturer merely needs to write a driver for Windows and the card will work with all Windows applications.

Multimedia Extensions works the same way. It is a set of dynamic link libraries (DLLs) that provide links between Windows applications and multimedia hardware. Multimedia Extensions already comes with a number of drivers, but like the rest of Windows, the system is designed to accept new drivers as they are created.

Microsoft Windows with Multimedia Extensions provides a standard platform to create and play back multimedia. To take full advantage of the new multimedia features, you need a CD-ROM drive with sound outputs, and a sound card with microphone and CD-ROM audio inputs, MIDI support, and sound outputs. (See "Do Multimedia Upgrade Kits and PCs Meet the Challenge?" in this issue.)

One of the most important points about Multimedia Extensions is that it can support new forms of hardware as the hardware becomes available. This is because one set of the extended functions is designed to access the MCI, or Media Control Interface, which is a sort of protocol layer that sits between Windows and the hardware devices. Through this interface, a Windows application can interact with any device that has a driver for Multimedia Extensions. Thus, you can open and play any MCI-aware device through a set of straightforward commands.

This open-ended design ensures that Multimedia Extensions can easily, seamlessly accept new hardware designs (video cameras, digital gloves, and devices we



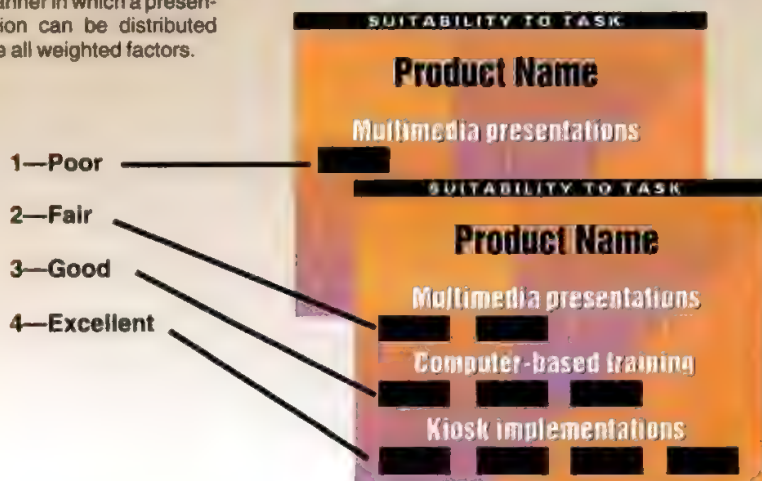
### SUITABILITY TO TASK

We tested the multimedia authoring system software with three different types of tasks: presentation, computer-based training, and a kiosk-type application. *Authorware Professional for Windows* and *IconAuthor* proved equally suitable for multimedia development, but differences in how they handle the overall authoring process will help you make your choice. *Multimedia ToolBook*, while less expensive, proved slower than the other products and required more programming experience.

**Multimedia presentations** evaluates the program's suitability for creating linear presentations integrating text, graphics, animation, and sound. Overall integratability of the disparate graphics elements, flexibility of timing mechanisms, and the manner in which a presentation can be distributed are all weighted factors.

**Computer-based training** focuses on the authoring system's ability to help you construct a complex interactive program, with heavy emphasis on conditional branching, program flow, data validation, hypertext functions, and underlying database support.

**Kiosk implementations** evaluates the program's adaptability to a public-access terminal application. Support for touch/click areas and hot buttons, full-featured branching, and multimedia integration are all important.





haven't even thought of as yet), just as Windows accepts new printers and displays.

#### SPOKEN WORDS, RESOUNDING MUSIC

How does Multimedia Windows (the combination of Windows and Multimedia Extensions) translate into tangible solutions? One of the most popular and easy-to-implement multimedia features is sound.

Long before the arrival of the PC, microcomputer users searched for innovative ways to transcend the tinny chirps and off-key buzzes that dominated the PC sound effects stage. Most audio solutions have been tied to specific applications; they required the applications to have device drivers to support a specific sound device.

Multimedia Extensions makes new audio possibilities available to many applications, especially multimedia authoring tools. Low-cost sound boards like Sound Blaster, Pro AudioSpectrum, and AdLib are all compatible with Multimedia Extensions, which can easily be used with any of these authoring systems.

Multimedia Extensions directly supports three separate sources of sound information: waveform (.WAV), MIDI, and CD-audio. Waveform audio provides a way to store sounds in digital form on your system's hard disk by sampling the sound at least 11,000 times a second and storing 8 bits of information per sample. As you might imagine, this can quickly add up to some large disk space requirements—more than a megabyte per minute for stereo sound. (For more information on waveform files, see Charles Petzold's Environments columns in the issues of November 12, November 26, and December 31, 1991.) Multimedia Extensions comes with Windows programs that allow you to record sounds and perform some simple editing. It also provides new functions that other applications can use to record and play back waveform files.

Another source of digital music is MIDI (Musical Instrument Digital Interface). Rather than storing sampled sounds, MIDI files consist of recipes for synthesized sounds. As a result, these files can be much smaller than waveform files of the same length; they require only about 30K per minute. (See "MIDI Goes Mainstream," also in this issue.)

The third form of sound doesn't require any hard disk space at all. Multime-



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dia Extensions makes it possible to play audio tracks from a CD-ROM, which use the same format as on an audio CD. This means that you can play any CD or any audio tracks that are included on a CD-ROM (such as the CD included with Media Vision Multimedia PC Upgrade Kit). You can select the track to play, then start, pause, or stop the sound as you choose.

Multimedia Extensions provides multimedia authors with new function calls that they can use to load one of these sound files, start it at the beginning or some other point, and then stop it at the end or at any other time. Windows can also be instructed to "set and forget" a sound file, getting it started and then continuing to execute other commands while the soundtrack plays.

Microsoft's MCI has functions for recording .WAV and MIDI files. Any of the packages that incorporate MCI support can support these types of audio, provided you create a presentation that executes the playback.

#### GRAPHICS IN MOTION

Another major component of a multimedia presentation is animation. There are a number of ways you can get images to move on-screen. The easiest is to take one or more bitmapped graphics images and "move" them across the screen by alternately drawing and erasing them, shifting the position in small increments each time, and recording the sequence (path animation). By changing the bitmapped image used for sequential images, you can also achieve the illusion of motion within the moving image (frame animation).

This approach can be time-consuming, however, and there are programs that you can use to create disk-based motion pictures. *MacroMind Director* for the Macintosh is one, and *Autodesk Animator* for the PC is another. The former creates files that you can move to the PC as .MMM files, while the latter creates .FLI files. Multimedia Extensions

drivers are available for both of these types of animation files, so the animation sequences they produce can become a part of your presentation. Some authoring programs offer simple animation features that let you take a bitmapped image and drag it around the screen to create an animation path.

#### VIDEO: THE NEXT FRONTIER

From the perspective of Multimedia Extensions, video is still under construction. Multimedia Extensions provides limited support for certain video devices, such as videodisk players, using the same sort of commands that are provided for sound and animation. But you must rely

on the hardware manufacturer for compatible drivers to make the equipment work with Windows. Once you have them working, these features let you play back video images on-screen as part of your presentation.

A more optimal solution is to use digital video, but a problem occurs when you try to store video sequences on a hard disk and then play them back at normal speed. Each frame in the sequence requires an enormous amount of storage space, and the computer is incapable of reading the data fast enough to display it on the screen at 30 frames per second, which is the

standard rate for animation.

Various compression techniques, including hardware-based approaches, are being tried to smooth the animation problem. Again, Multimedia Extensions has a big advantage because as new devices appear, capable of greater playback speeds, they will be easy to support through the MCI commands.

Right now, there are three different ways to support video images on a PC. *Analog video* relies on a videotape or disk as the source of a video signal. This requires an overlay card or frame grabber in the PC to digitize the signal so that it can be added to the image on the PC's display.

*Hardware-assisted digital video* uses hardware to compress and decompress digitized video images. Designs under

Waveform audio  
provides a way  
to store sounds  
in digital form  
on your system's  
hard disk  
by sampling  
the sound.





## MULTIMEDIA

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development are based on the JPEG standard (named for the Joint Photographic Experts Group), which was really designed for still images, and the newer MPEG standard (from the Motion Picture Experts Group) for sequences of images. Intel is working on its own DVI (Digital Video Interactive) approach, which is already in alpha testing with Multimedia Extensions.

Microsoft is using Multimedia Extensions to take a "software-assisted digital video" approach. Microsoft's new AVI (Audio Video Interleaved) standard is designed to decompress images quickly from a digital storage device. The standard is tuned for a CD-ROM throughput rate—150K per second—and can be used to create a 160-by-120-pixel image in 256 colors on-screen with a 15-frame-per-second display rate. The system allows for trade-offs, however, so you can make a larger image at a slower frame rate or opt for a higher compression ratio with some

loss of picture quality. AVI is also in alpha testing.

With analog video solutions fairly well defined, we are still waiting for the emerging digital standard. You can count on seeing many new developments in this area in the coming year, and you can count on the MCI's ability to accommodate the new technologies as they appear.

If you want to add sophisticated video special effects to your productions, you will need more than Multimedia Extensions. Some of the programs in this review provide their own direct support of other, more specialized video devices. This additional support—for example, using boards such as the VideoLogic DVA-4000—can let you display full-motion video sequences on-screen.

One program we reviewed, *IconAuthor*, lets you shrink or crop a video

image to occupy only a portion of the screen. Some video capabilities require additional hardware. For example, if you want to combine the video image with your disk-based images, you will need a video overlay card. We did not include any video capabilities in our testing process because we wanted to focus on the potential of PCs equipped with MPC upgrade kits, and not much has changed on this front since we discussed the subject in "Multimedia: The Next Frontier for Business?", July 1990.

#### TOOLS FOR TEXT AND GRAPHICS

Of course, authoring systems can handle text and graphics, which make up the major portion of most multimedia presentations. They can display bitmapped graphics from a variety of formats, as full-screen or cropped or scaled images, with a variety of transition effects. They also include simple paint and image-editing tools. Some can even perform simple animation tasks by moving a small image across the screen; you just drag the picture and release it to mark the intermediate points along the intended path.

The programs can show text on-screen in a range of fonts and sizes, often taking the text from a separate file—which means that you can update a presentation by editing a simple ASCII text file instead of some complex graphics image.

#### NAVIGATIONAL TOOLS

Beyond their ability to combine the disparate elements of a multimedia presentation, another important aspect of authoring programs is their ability to create complex flow structures with conditional branches and logical loops. This makes the multimedia presentation especially interactive: You control the revelation of the information. You can jump ahead to a particular part of a presentation based on user input; you can have a keystroke or mouse click spawn a chain of events; you can judge user input and offer corrections; you can have hot buttons on-screen that link to other parts of the presentation.

All of these activities provide functionality above and beyond what is required in your average business presentation. The ability to take a course of action depending on user responses makes these programs suited for creating *computer-based training* (CBT) applications, which can test and score student performance, for example.



#### EDITORS' CHOICE

##### ■ Authorware Professional for Windows

Two of the packages we reviewed, *Authorware Professional for Windows* and *IconAuthor*, use a flowchart paradigm to design a presentation. The third, *Multimedia ToolBook*, relies on a hypercard-like environment. The packages all get you to the same place—a multimedia presentation—but they require different mind-sets and have wildly different costs. Besides using different paradigms to specify the *form* of a presentation, they have different strengths and weaknesses regarding the implementation of *content*.

One thing is clear: If you are a business user who merely wants to create a multimedia presentation a few times a year without having to invest a great deal of time mastering an authoring system, then none of these are for you. You would be better off with one of the presentation graphics products reviewed in the previous issue (March 17, 1992). All three of the present programs require a substantial effort.

If you are willing to devote the time and money to use one of these packages, *Authorware* is the winner.

It is the easiest to learn and use, and it provides the best access to the features offered via Microsoft Windows with Multimedia Extensions. Furthermore, its runtime module lets you compile your presentation into a single executable file (albeit a rather large one), and this makes distribution easier. Although *IconAuthor* received identical Suitability to Task ratings in this review, *Authorware* gets you to the same place with less effort. And although *ToolBook* costs a fraction of the price, it requires more programming expertise.

The other programs have their own strengths, and each deserves an honorable mention. *IconAuthor* is particularly strong when it comes to incorporating video. (The video support is based on *IconAuthor*'s own drivers, outside the realm of any Multimedia Extensions features.) *Multimedia ToolBook*, with its low price and royalty-free runtime, is especially attractive for those with more time than money to invest in development tools. It also has some distinct advantages for creating hypertext-type applications.



## MULTIMEDIA METAPHORS

In this review, we look at three packages that let you create multimedia productions using Microsoft Windows with Multimedia Extensions. We looked at *Authorware Professional for Windows* from Authorware, *IconAuthor* from AimTech, and *Multimedia ToolBook* from Asymetrix. *Authorware* and *IconAuthor* design their presentations using a flow-chart metaphor. *ToolBook* uses a scripting language tied to something Asymetrix calls *pages*. There is a more than tenfold difference in price between the most expensive and least expensive packages, indicating that they are aimed at different markets and different uses.

*Authorware*, the most expensive entry, has unusually strong branching and control features, which make it especially suitable for CBT (computer-based training) applications. *Multimedia ToolBook*, the product with the lowest price tag, excels in the development of hypermedia applications, while *IconAuthor* has the most powerful and flexible video support of the three packages.

Another important area to consider when selecting one of these programs is the question of how the productions are to be distributed and used. All three products come with runtime modules, but there are widely varying royalty terms for distributing these modules with your productions. (Note that we have cited the basic, list-price terms for all the products, but many special pricing arrangements are available, especially for educational organizations.)

As sophisticated as these three programs are, there is still room for improvement. For example, they all rely on the completion of one task before another starts. This can make it difficult to synchronize events. Instead of specifying a "slow fade" as a transition between two images, as currently required, it would be better if you could specify start and end times based on the time elapsed since the start of the presentation, like the SMPTE (Society of Motion Picture and Television Engineers) times used in professional video production.

## OTHER ROADS

Since Multimedia Windows will ultimately turn authoring into a mainstream application, we chose to look only at Windows-based programs that support Multimedia Extensions. The programs had



## MULTIMEDIA

### Authoring Software

to be capable of creating both multimedia presentations and computer-based training programs.

Certain DOS-based programs, such as Allen Communication's *Quest* and Computer Teaching Corp.'s *TenCORE Language Authoring System*, are well respected in the arena of computer-based training, but they are geared more toward professional media creators.

There are also products that let you dabble in the world of multimedia without drowning. They do not offer the full range of authoring features contained in the products we review, but they include support for Multimedia Windows. For example, MacroMind's *Action!* is a presentation graphics package that supports multimedia sound and animation files. Gold Disk's *Animation Works Interactive*, an animation product, can play .WAV sound files. Both can help you create lovely presentations with a fair amount of interactivity. In addition, AimTech will be coming out with a lower-priced personal multimedia package later this year, and Authorware has an OEM product called *Authorware Star* that will be bundled by vendors of multimedia-compatible computer systems, including Acer America Corp.

## TESTING, TESTING

To evaluate the power and versatility of the products included in this review, we created two multimedia applications from outlines developed by PC Magazine Labs. The first application was a multimedia presentation that stressed timing, media element compatibility, and other key aspects of presentation creation. We imported and manipulated 16- and 256-color bitmapped images as well as a variety of vector-based graphics. We also tested the text-editing features by importing, editing, and redesigning text. Next, we tested hypertext capabilities by creating hot buttons, and we imported MIDI and waveform audio into the presentations as well, paying particular attention to voice-overs.

The second application was a CBT system that put special emphasis on integrating not only the authoring systems' multimedia support but their conditional logic and capabilities for advanced data handling as well. Also incorporating text, graphics, animations, and sound, the training application presented the end user

with a tutorial followed by a four-question quiz. As the end user answered the questions, we evaluated various data validation and calculation features of each program. The responses for the quiz were stored in a file, testing the product's database support.

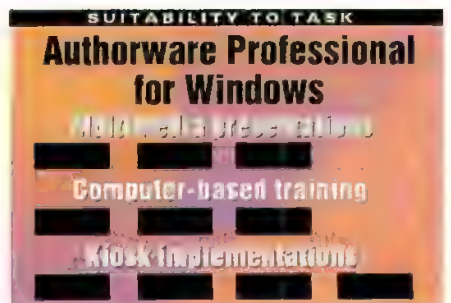
We created the test applications on a Compaq Deskpro 386/25e with 8MB of RAM, an ATI VGA Wonder XL graphics controller in 256-color VGA mode, and a Media Vision Multimedia PC Upgrade Kit. We used Passport Designs' *Media Music*, a CD-ROM full of MPC-compatible sound and music clips to furnish sound. Finally, we tested both applications to assess how well they would run in a touch-screen kiosk.

Multimedia authoring packages give you the ability to stage a presentation that will put your competitors to shame. With sound, color, and motion, you can create productions that will hold your audience's attention so that you can deliver your message more effectively than ever before. Multimedia authoring packages also give you the power to let your users navigate through information at their own pace, in their own sequence. Each of the three programs we review here provides the tools you need to make it happen.

## ALL REVIEWS BY ALFRED POOR

### Authorware Professional for Windows

If the name *Authorware Professional for Windows* doesn't say it, then the \$8,000 list price will get the point across: This is an industrial-strength authoring tool. While you probably won't want to pick this for casual use, *Authorware*, which originated on the Mac, has some clear strengths for creating presentations using the Multime-





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## MULTIMEDIA

### Authoring Software

dia Windows features.

Like *IconAuthor* (reviewed next), *Authorware* relies on a visual flowchart paradigm, where you create productions by dragging and dropping icons to create a flowchart representation of the application's structure. But *Authorware* takes this complex process and does its best to simplify matters. Unlike *IconAuthor*, which has many icons, *Authorware* has only 11. *Authorware*'s 11 icons are smaller and represent only black and white instead of color, but behind their simplified visual representation lies a great deal of power.

#### MAPPING A PRESENTATION

Map icons are *Authorware*'s powerful tool for letting you create a modular presentation. If you insert too many icons, so that part of the chart is pushed beyond

the bottom edge of the window, there are no scroll bars to let you see the end of the chart, as there are with *IconAuthor*. This is where the Map icon—a sort of visual outliner—comes into play. Highlight a section of the chart and click on the Map icon and the section will collapse into a single icon. Double-click on that icon and a new window will open to reveal the icon's contents. This lets you view your production in outline form, and also lets you create modular routines that can be saved and then reused in other presentations. So even though *Authorware* can only have one presentation file open at a time, Map icons circumvent the limitation.

Thus, *Authorware* forces you to work in small, manageable portions of a large

presentation instead of trying to display all the detail at once. This is a healthier approach than that used by *IconAuthor*, where you must scroll around or zoom out to see the different parts of your flowchart.

The other *Authorware* icons are fairly straightforward in their purpose. The Display icon puts text and graphics on the screen, and the Animation icon allows you to move a graphics image around the screen along straight or curved paths. (You can also play canned animations from other applications.) The Erase icon lets you selectively remove items from the screen. The Wait, Decision, and Interaction icons control the flow of the application, including branches, loops, and delays. The Calculation icon can be used to perform mathematical processes; it is also used to call special control functions

## THE MDK: Down-and-Dirty Multimedia Programming

by Charles Petzold

If programming were easy, some of us would be out of jobs and the rest would have long since solved the mysteries of the universe. But programming is never easy. While multimedia authoring tools promise to deliver ease of use, they are not quite as simple as you might hope, and you also lose a certain amount of flexibility.

For maximum power and flexibility in writing Multimedia Windows applications, you may need to get down and dirty and do it in C. And for that you need the Microsoft Multimedia Development Kit (MDK).

The MDK is basically an add-on to the Microsoft Windows Software Development Kit (SDK) or the Borland C++ compiler. It contains the additional elements that C programmers need to write programs for Multimedia Windows or to add multimedia capability to existing Windows applications.

Even for nonprogrammers using authoring tools to develop multimedia titles, the MDK can be important. For instance, it contains the primary documentation of the Media Control Interface (MCI) and some useful tools—in particular, Multimedia Viewer, an authoring system.

All MDK software is provided on one CD-ROM, including:

- Multimedia Extensions to Windows, which you can install on top of Windows 3.0;

- header files and import libraries you need to take advantage of the multimedia extensions in Windows programs written in C;

- development tools, including a bitmap editor, a palette editor, a waveform audio editor, a file conversion utility, and a structured-file viewer and editor;

- on-line help information, with documentation of the Media Control Interface (MCI) and the approximately 135 function calls that comprise the multimedia application program interface (API);

- sample applications, some of which are actually useful (such as MCITEST, which you can use for interactive MCI scripting);

- sample MIDI and waveform audio files;

- a sample Multimedia Viewer title.

Six manuals included in the MDK contain overviews, tutorials, a programmers' reference, and a multimedia authoring guide. Finally, a 3.5-inch Macintosh floppy disk has a utility to convert animation sequences created by *MacroMind Director* to a format suitable for Multimedia Windows.

Microsoft has learned a great deal

over the past six years about putting together programmers' toolkits. The tutorials may be confusing in spots, some of the technical documentation may read like black magic, and the tools may seem like rudimentary prototypes for better tools that may someday be available from other software vendors, but in general the MDK is a whole lot better than the original Windows SDK, and even somewhat better than the current version.

#### THE MULTIMEDIA VIEWER

The most sophisticated tool in the MDK is Multimedia Viewer, an authoring tool that supports almost nothing we normally associate with programming or scripting, such as control flow, variables, or arithmetic. That limits its versatility, of course, but for certain types of multimedia titles (electronic encyclopedias, for example), Viewer can be ideal.

If you want to create a Viewer document, you are required to use *Microsoft Word for Windows*. You assemble text and bitmaps into *topics* (which are like electronic pages) and then link these topics into *books* by specifying *hotspots*. The hotspots may be either text strings or areas of bitmaps. Hotspots can also trigger the playback of waveform audio



## MULTIMEDIA Authoring Software

including user-defined procedures, or to jump to another file or program. In addition, there are Video, Sound, and Movie icons, but these are for use with peripherals that are not supported through Multimedia Windows.

You add an icon by dragging it and dropping it in the appropriate spot in your flowchart. As you might surmise, each icon can serve a number of different functions. For example, if you double-click on the Display icon, the program will open a Graphics editor where you can draw basic shapes, add text, or import graphics images.

### TOP-NOTCH INTERACTION

A number of configuration options make it easy to include some impressive interactive features in your presentation. For example, when you create a loop for the

user to answer a question (as in a training application), you can limit the number of attempts or the length of time for a response. You can offer multiple-choice answers, or you can have the user type in text, and a sophisticated string-matching feature will watch for the right answer. You can easily create hot zones to accept mouse-click responses from the user, since you can drag and resize the areas quickly. *Authorware* can also draw attractive buttons and check boxes automatically.

Record-keeping is also fairly straightforward, using the Calculation icon. You can set up an application that keeps track of a user's number of right answers and the number of attempted answers, and then branch to different sections based on criteria that consider both factors.

The Calculation icon is also used to access Multimedia Windows features. In a more complicated procedure than you would think necessary, you access Multimedia Extensions by using the program's User functions as a prompt to paste in the syntax. These functions are not included as part of the default setting, but are contained in a DLL (dynamic link library) included in the package. You can

install User functions for waveform or MIDI audio, animation, and generic MCI device support. With these installed, you can cut and paste the formula syntax for a specific medium into a Calculation icon's dialog box. This is not as convenient as it could be, but it works. The documentation includes a separate Multimedia reference manual that provides some additional help by detailing the various functions and their syntax.

The Macintosh roots of this program shine through. Although we did not test this aspect, *Authorware* is designed so that you can develop productions that will execute on either Macintosh or DOS-based systems; the program even includes a Windows font designed to look like the Mac. Another unique feature is that *Authorware* can compile a production to include the runtime module, resulting in a standalone .EXE file that runs under Windows. (You do have to include any DLL files you might have used within the production, however; they do not get included in the executable file.) The resulting file can be rather large; one of our test applications, nine full-screen bitmapped images, resulted in a 5.8MB file. But remember that this includes the images along with everything else.

files, MIDI files, or animations. Index and search facilities are provided, and yes, you can make calls to dynamic link libraries.

How sophisticated can a Viewer application be? Take a look at the first commercial Viewer application—Microsoft's *Bookshelf for Windows*. *Bookshelf* seems to implement just about every feature of Viewer, and it's a very fine piece of work.

### Microsoft Multimedia Development Kit, Version 1.00

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080.

**List Price:** \$495. **Requires:** 286-based PC or better; 2MB RAM; 30MB hard disk space; VGA adapter and monitor; DOS 3.1 or later; MS-DOS CD-ROM Extensions 2.2; Microsoft Windows 3.0; Microsoft Windows Software Development Kit (SDK); any Windows-compatible C compiler; mouse; audio board. 386-based PC with 4MB RAM and 256-color VGA recommended. **In Short:** The MDK is the official and essential package for C programmers writing Multimedia Windows applications. Also included is Viewer, a rudimentary authoring tool for nonprogrammers.

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*Authorware Professional for Windows, Version 1.0*

Authorware Inc., 275 Shoreline Dr., #535, Redwood City, CA 94065; 800-288-8108, 415-595-3101.

**List Price:** \$8,000.

**Requires:** 286-based PC or better (386 recommended); 2MB RAM for 16-color graphics, 4MB for 256-color; 20MB hard disk space (40MB recommended); EGA, VGA, Super VGA, or XGA adapter and monitor; Microsoft Windows 3.0 or later (Multimedia Extensions recommended).

**In Short:** Pricey but professional, *Authorware* is the best choice for sophisticated applications that use Multimedia Extensions. It has a lean but powerful flowchart interface, based on icons, and many easy, useful features.

CIRCLE 468 ON READER SERVICE CARD

### A PROFESSIONAL'S PARADISE

*Authorware* is complex and takes some commitment to learn thoroughly, but the program comes with an excellent printed tutorial. The left page of each spread has a visual representation of the steps for that part of the lesson, plus abbreviated instructions. The right page has detailed explanations of the individual steps and the reasons for them. Thus, you can move quickly through the steps you understand, but get additional detail if you need it without leaving your place in the lesson.

The program also comes with a number of sample applications that you can explore, as well as a collection of *models*, which are segments of code you can add to your own applications. You simply load a model file from disk, adding it to the Models menu. You can then add the model to your presentation as a Map icon and edit individual icons as necessary.

If you want to develop applications that take advantage of Multimedia Windows, and you want them to be fairly easy to create and maintain, *Authorware* is probably your best bet. If you perform this sort of authoring enough, the pack-



age's \$8,000 price tag may be justified.

A nonprofessional version of *Authorware* called *Authorware Star* will soon be available. *Authorware Star* is being sold directly to manufacturers of multimedia-compatible PC systems. One of the first to distribute the product will be Acer America Corp., starting later this year.

## IconAuthor

*IconAuthor*, from AimTech Corp., has changed since we reviewed it in our first roundup of multimedia authoring tools ("Multimedia: The Next Frontier for Business?", July 1990), and the changes have been all for the better. Not only is the icon-based interface easier to manage, but the program now boasts support



## MULTIMEDIA Authoring Software

for Multimedia Windows. Its list price of \$4,995 places it midway between the other two products in this review, but *IconAuthor* has some standout features that help set it apart.

One of the most important features of the latest release of *IconAuthor*—Version 4.0—is that it adds support for Multimedia Windows. Equally important is the way it builds on the strengths of the earlier versions to provide users with a visual way of creating multimedia presentations.

### A VISUAL APPROACH

Like *Authorware Professional for Windows*, *IconAuthor* takes a visual approach to authoring multimedia productions on a PC. For example, to tell the program to show a graphics image on the

screen, you select a Display icon from a scroll bar along the left side of the screen, then drag it to the work area and drop it. You can then add an Input icon to tell the program to wait for a key press or mouse click before advancing to the next step. As you add icons, they are automatically connected to create a visual flowchart of your multimedia production. Dropping an icon between two others means you are inserting it; moving an icon from the flowchart and dropping it on a Trash Can icon deletes it. You can also highlight ranges of icons for block operations such as cut, copy, and paste.

Icons give the presentation its form; they determine the progression of how the elements flow. Double-clicking on an icon reveals either its content window or its dialog box. The dialog box is where you assign specific details, such as the name of the image file to be loaded, the

## A GUIDE FOR HYPERTEXT

by Alfred Poor

*Guide*, from OWL International, did not meet the selection criteria for this review, but it is worthy of mention. While it offers support for Microsoft Windows with Multimedia Extensions through the use of MCI commands, it differs in its mission from the other three packages.

*Guide* is specifically designed for creating hypertext productions. Since you can add sound, animation, and even video, the company prefers to refer to developing "hypermedia" presentations instead of just hypertext.

Text remains the fundamental focus for *Guide* productions, however. You can enter or import text files, which you then mark to create buttons. Different types of buttons can trigger different kinds of events. A Note button pops up a window that can show more information about the text, such as a definition for the selected word. An Expansion button causes a topic heading to expand to show the detailed text it contains, and Reference buttons cause the program to jump to other sections of text.

### LOGIIX LANGUAGE

You can dress up these screens with various graphics elements, and you can link the graphics to text. Simple proce-

dures can be defined using the menus and keyboard shortcuts, but for advanced operations you will have to code your instructions by using LOGIIX, OWL International's proprietary command language. This might be sticky for non-programmers, but it gives you access to a wealth of features, including DDE (dynamic data exchange) with other Windows programs. You must also use the command language to access Multimedia Extensions features. The multimedia features are only available in *Guide* 3.05, or when purchased separately as *Guide Media Extensions*.

Examples of LOGIIX code are included in *Guide*'s sample applications, but there are no LOGIIX tutorial exercises, and the reference manual is a bit disjointed in this area. Therefore, there is no easy way to drop sample code into your programs; in most cases you must code each from scratch.

The program has no database interaction features, which means that while it can give information to the user, it is not designed to store user responses (as required by our CBT test).

A separate product, *Guide Reader*, is a playback-only program for books that *Guide* has created. The list price of

*Reader* is negotiated based on the type of site installation.

*Guide* is not well suited for the kinds of applications we used for testing in this review. But if you have large sections of text that you want to organize so users can jump between links and take advantage of other hypertext presentation features, *Guide* provides a relatively quick and easy way to develop such a system. While adding multimedia features is not easy, having access to them at all is a definite plus. ■

### *Guide*, Version 3.0

OWL International Inc., 2800 156th Ave. S.E., Bellevue, WA 98007; 800-344-9737, 206-747-3203.

**List Price:** \$495. **Requires:** 286-based PC or better; 1MB RAM; 2MB hard disk space; EGA monitor and adapter or better (VGA recommended); DOS 3.1 or later; Microsoft Windows 3.0; Windows-supported pointing device. **In Short:** While *Guide* does support the Multimedia Extensions features through MCI commands, it is best suited to importing existing text for transformation into hypertext electronic documents.

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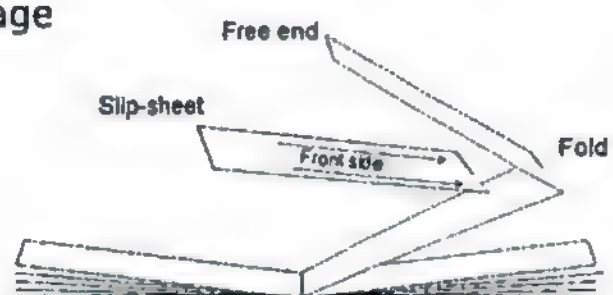
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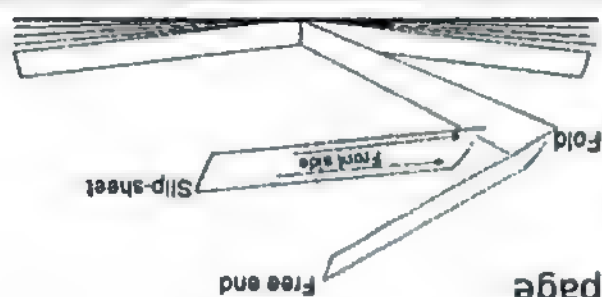


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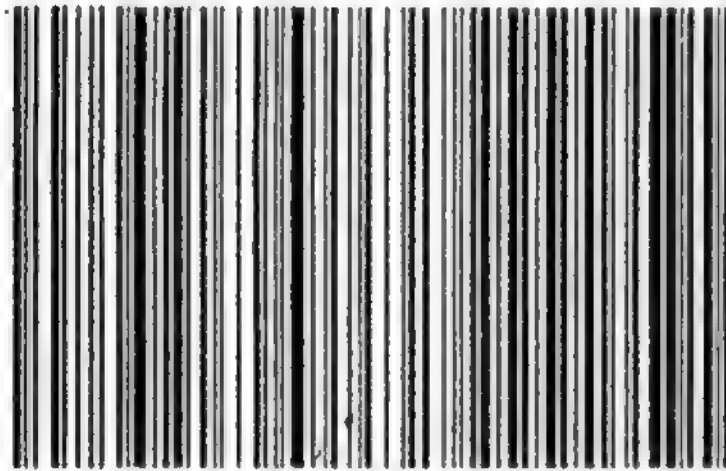
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- External keyboard port
- MS DOS 5
- Leather carrying case
- 8.66" x 11" x 2.08", 6.5 lb.

*\*Also available with 60MB hard drive for \$1,895*

Lease for **\$1,995**  
\$80/month

## 386/SX-25 CACHE SYSTEM

- 80386SX, 25MHz Processor with cache
- 4MB RAM expandable to 32MB
- 1.44MB, 3.5" drive
- 1.2MB, 5.25" drive
- 100MB IDE, 18ms hard drive
- 16-bit VGA, 512K
- Super VGA color monitor (1024 x 768 resolution)
- 1 parallel port/2 serial ports
- 101-key enhanced keyboard
- Serial mouse
- MS DOS 5
- MS Windows 3.0
- User Upgradable

Lease for **\$1,795**  
\$72/month

## 486/33 SYSTEM

- Intel 80486, 33MHz Processor
- 4MB RAM expandable to 32MB
- 1.44MB, 3.5" drive
- 1.2MB, 5.25" drive
- 200MB IDE, 18ms hard drive
- 16-bit VGA with 1MB
- Super VGA color monitor (1024 x 768 resolution)
- 1 parallel port/2 serial ports
- 101-key enhanced keyboard
- Serial mouse
- MS DOS 5
- MS Windows 3.0
- User Upgradable

Lease for **\$2,695**  
\$108/month

## 486/33 EISA CACHE SYSTEM

- Intel 80486, 33MHz Processor
- External zero-wait state
- 64KB static RAM cache
- 8MB RAM expandable to 64MB
- 1.44MB, 3.5" drive
- 1.2MB, 5.25" drive
- 200MB IDE, 18ms hard drive
- 16-bit VGA with 1MB
- Super VGA color monitor (1024 x 768 resolution)
- 1 parallel port/2 serial ports
- 101-key enhanced keyboard
- Serial mouse
- MS DOS 5
- MS Windows 3.0
- Tower Case

Lease for **\$4,395**  
\$176/month

\* Monthly lease rates based on length of lease.

• TRW Customer Service Division. Free one year on-site service for 386/SX, 386, 486/SX, and 486 EISA systems. On-site service for 286 systems available at extra cost. Free on-site is available to most locations in the contiguous United States.

• PC Brand reserves the right to amend specifications and prices without notice. Intel is a registered trademark of the Intel Corporation.

All other products or services are identified by the trademarks or service marks of their respective companies. ©1992 PC Brand, Moorpark, California.

\* Custom configurations available.

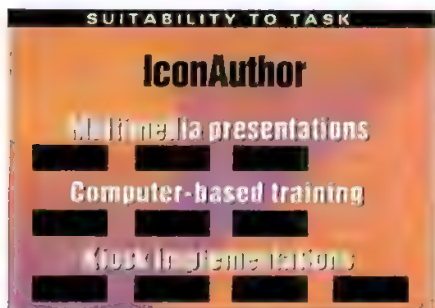
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length of time the program should pause, or the kind of event that should trigger the next action. In most cases, you fill in the blanks or respond to other prompts; the process is fairly easy.

IconAuthor has plenty of tools you can use to develop interactive presentations. The Tool icons are organized into functional groups, which are represented by folders on the toolbar. You can open a folder to reveal its contents, or if you are not working with those features at the moment, you can close the folder to keep the list of available icons more manageable. Compared with the older versions of IconAuthor, which did not hide the nonessential elements from view, the new screens are far more attractive and easier to use.



#### IconAuthor

AimTech Corp., 20 Trafalgar Sq., Nashua, NH 03063-1973; 800-289-2884, 603-883-0220.  
List Price: \$4,995.

**Requires:** 286-based PC or better; 1MB RAM for 16-color graphics, 2MB for 256-color; 10MB hard disk space (20MB recommended); CGA, EGA, VGA, or Super VGA adapter and monitor; DOS 3.1 or later; Microsoft Windows 3.0 or later (Multimedia Extensions recommended); mouse or Windows-compatible input device.

**In Short:** IconAuthor's flowchart-based interface is easy to use but can become unwieldy for large productions. Its support for Multimedia Extensions is adequate, but its video features are much stronger.

## MULTIMEDIA Authoring Software



### SUMMARY OF FEATURES

Products listed in alphabetical order

☒ —Editors' Choice  
☒ —Yes ☐ —No

|                                   | Authorware Professional for Windows                                       | IconAuthor                                                                | Multimedia ToolBook                                                       |
|-----------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| List price                        | \$8,000                                                                   | \$4,995                                                                   | \$695                                                                     |
| Unlimited runtime version         | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| Training included                 | 3 days                                                                    | 4 days                                                                    | None                                                                      |
| <b>DEVELOPER INTERFACE</b>        |                                                                           |                                                                           |                                                                           |
| Icon flowchart                    | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |
| Nested flowcharts                 | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/> (separate file)                       | N/A                                                                       |
| Text-based                        | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| Multiple documents open           | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |
| Zoom views                        | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Ribbon bar or toolbox             | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Debugging utility                 | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| Security privileges:              |                                                                           |                                                                           |                                                                           |
| Create and edit                   | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| Access and read only              | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| Presentation window:              |                                                                           |                                                                           |                                                                           |
| Hide menu bars                    | User option                                                               | <input checked="" type="checkbox"/>                                       | User option                                                               |
| Hide title bars                   | User option                                                               | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |
| <b>WINDOWS SUPPORT</b>            |                                                                           |                                                                           |                                                                           |
| Accepts DLLs                      | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| DDE send/receive                  | <input checked="" type="checkbox"/> / <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> / <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> / <input checked="" type="checkbox"/> |
| OLE                               | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  |
| Multimedia Extensions support     | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| <b>VIDEO SUPPORT</b>              |                                                                           |                                                                           |                                                                           |
| VCR                               | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |
| Videodisk                         | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/> (through MCI)                         |
| Full-screen                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Cropped/scaled                    | <input type="checkbox"/> / <input type="checkbox"/>                       | <input checked="" type="checkbox"/> / <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> / <input type="checkbox"/>            |
| Keyed overlay support             | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |
| <b>DEVICE SYNCHRONIZATION</b>     |                                                                           |                                                                           |                                                                           |
| SMPTE timing                      | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  |
| Concurrent timing                 | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Event-driven timing               | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| <b>DATA FILE SUPPORT</b>          |                                                                           |                                                                           |                                                                           |
| Proprietary                       | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |
| ASCII (delimited or fixed-length) | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| dBASE                             | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/> (through included DLL)                |
| Verify file exists                | N/A                                                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Create file                       | N/A                                                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Pack file                         | N/A                                                                       | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| Reindex file                      | N/A                                                                       | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       |
| <b>GRAPHICS</b>                   |                                                                           |                                                                           |                                                                           |
| Maximum number of colors:         |                                                                           |                                                                           |                                                                           |
| Display                           | 256                                                                       | 16 million                                                                | 256                                                                       |
| Edit                              | 256                                                                       | 256                                                                       | 16                                                                        |
| Gradient color                    | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |
| Transition effects                | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Animation:                        |                                                                           |                                                                           |                                                                           |
| Point to point                    | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       | <input checked="" type="checkbox"/>                                       |
| Straight-line path                | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  |
| Curved path                       | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  | <input type="checkbox"/>                                                  |
| Simple cel animation              | <input type="checkbox"/>                                                  | <input checked="" type="checkbox"/>                                       | <input type="checkbox"/>                                                  |

N/A—Not applicable: The product does not have this feature.

CONTINUES





# MULTIMEDIA

## Authoring Software

### SUMMARY OF FEATURES

—Editors' Choice  
☒—Yes ☐—No



Authorware  
Professional  
for Windows

IconAuthor

Multimedia  
ToolBook

#### FILE FORMAT SUPPORT

##### Graphics:

.BMP  
.PCX  
.RLE  
.TIFF

☒  
☒  
☐  
☒

☒  
☒  
☒  
☐

☒  
☐  
☐  
☒

Windows Clipboard  
.WMF  
Other

☒  
☒  
☒

(bitmap only)  
None  
.DIB, EPS,  
Macintosh Pict  
and Paint

☒  
☒  
☒

CGM, .DIB, .DRW,  
EPS

##### Sound:

.MID  
.SND  
.WAV  
Other

☒ (function call)  
☐  
☒  
☒

☒ (function call)  
☒ (function call)  
None

☒ (function call)  
☐ (function call)  
None

##### Animation:

.FLI  
.MMM  
Other

☒ (through MCI)  
☒ (through MCI)  
☒ .MOV

☒ (through MCI)  
☒ (through MCI)  
Proprietary

☒ (through MCI)  
☒ (through MCI)  
None

##### Presentations in executable format

#### OTHER PLATFORMS

Macintosh  
Unix

☒  
☐

☐  
☒

☐  
☐

ENDS

### HANDY FOLDERS

The program has seven group folders for the Tool icons: Flow, Input, Output, Data, Multimedia, Custom, and Extensions. The Flow folder includes icons for typical program flow control routines, such as menus, if-then branches, and loops. Input icons let you design a presentation that accommodates user entries from the keyboard or mouse, while Output icons handle everything from putting bitmapped images on the screen to simple text and graphics drawing or sending output to printers or disk files. The Data folder contains icons for managing variables—for instance, reading and writing values stored in disk files—and working with *dBASE* files. The program's system of variables makes it easy to track user responses for scoring or other feedback.

The Multimedia folder can be a little misleading, since the only icon that accesses components supported by Multimedia Windows is a generic MCI icon. The rest of the icons in the folder handle video and sound functions directly through *IconAuthor*. A Custom folder contains a set of prebuilt MCI routines designed to

help you add sequences that access CD-audio, MIDI, and waveform audio elements. The last folder, called Extensions, contains icons for advanced elements such as DDE and DLL support, controlling external devices through a serial port, and managing subroutines.

The *IconAuthor* menu options provide some powerful tools to help you as you build your production. You can use the Zoom feature to move in and out on your flowchart, and scroll bars will appear if your flowchart is too long or too wide to fit on the screen. You can open more than one production flowchart at a time—which is extremely handy when you are creating a new production based on an existing one, since you can simply copy and paste sets of icons from one window to another. Viewing more than one flowchart can also be useful when you are working with subroutines, since these are stored in separate files from the main application. *IconAuthor* can tile or cascade all open flowchart windows through a menu command.

Ribbon bars with buttons for frequently used commands seem to be the rage these

days, and *IconAuthor* follows the pattern. Buttons are provided for many handy functions, such as Cut, Copy, and Paste. Other buttons allow you to test your production, starting either from the beginning or from the highlighted icon. The latter option is especially useful when you are trying to build or debug a complex sequence in the middle of a production and you do not want to start at the beginning every time.

### ALL THE BUILDING BLOCKS

*IconAuthor* provides plenty of tools for creating individual images as well. In fact, the package includes five additional programs that allow you to create images within *IconAuthor*. The Graphics editor is a simple drawing program. The Smart Text editor allows you to create attractive text displays for your screens using a wide range of impressive effects, including three-dimensional boxes and frames. *IconAnimate* allows you to move bitmapped images across the screen on point-to-point paths. This is extremely easy: You simply drag the image across the screen and release it at the points where you want it to go. You can also use the animator for simple frame animations, but this requires careful use of an image buffer feature that takes some practice to use effectively.

There is also a Video editor that can be used for complex video effects. The Video editor relies on a supported video-disk or videotape player in conjunction with a supported video overlay card. Finally, there is a utility called *RezSolution*, which can be used to change the format and dimensions of a bitmapped image. This is handy for importing images of different origins. *RezSolution* even has a batch mode that can be used to make the same change to many files in one pass, which is a welcome feature.

*IconAuthor* is undoubtedly a sophisticated and feature-rich program, but it is not easy to learn. AimTech recognizes this and includes four days of training in the package price.

*IconAuthor* has the best video support among the three packages in this group. If you plan to use videodisks or videotape in your productions, this is a reasonable choice. Many of the other features are intuitive, such as creating "hot zones" on-screen to accept input, and most features can be accessed easily by either keyboard or mouse. The Smart Text feature makes it simple to create flexible



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# MULTIMEDIA

## Authoring Software

### SUMMARY OF FEATURES

—Editors' Choice  
☒ Yes ☐ No

Authorware  
Professional  
for Windows

IconAuthor

Multimedia  
ToolBook

#### FILE FORMAT SUPPORT

##### Graphics:

.BMP  
 .PCX  
 .RLE  
 TIFF

☒  
☒  
☒  
☒

☒  
☒  
☒  
☒

☒  
☐  
☐  
☒

Windows Clipboard  
 WMF  
 Other

☒  
☒  
☒

(bitmap only)  
☒  
 None

☒  
☒  
 CGM, .DIB, .DRW,  
 EPS

##### Sound:

.MID  
 .SND  
 .WAV  
 Other

☒ (function call)  
☐  
☒  
 PCM

☒ (function call)  
☒  
☒ (function call)  
 None

☒ (function call)  
☐  
☒ (function call)  
 None

##### Animation:

.FLI  
 .MMM  
 Other

☒ (through MCI)  
☒ (through MCI)  
 .MOV

☒ (through MCI)  
☒ (through MCI)  
 Proprietary

☒ (through MCI)  
☒ (through MCI)  
 None

Presentations in executable format

☒

☐

☐

#### OTHER PLATFORMS

Macintosh  
 Unix

☒  
☐

☐  
☒

☐  
☐

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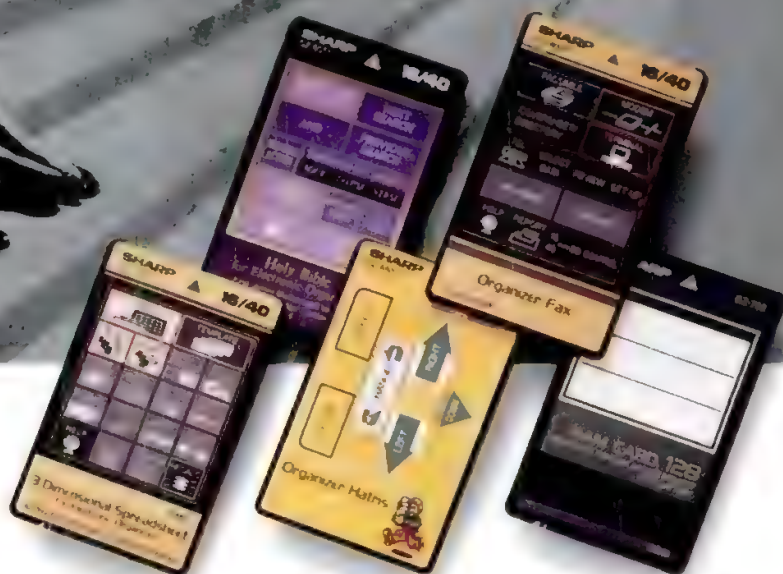


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## MULTIMEDIA

### Authoring Software

productions that accept changes easily.

On the other hand, there are some weaknesses. Support of Multimedia Windows is limited to the MCI icon, and despite the few custom routines on the icon toolbar, the MCI icon is difficult to use. It is poorly documented, relying mostly on a Windows help file. While the program's own animation feature is easy to use, the motion can be uneven and has an unpolished look.

*IconAuthor* also slavishly adheres to a file management system that forces you to put all files of a given type in the same subdirectory. And though the flowchart interface is easy to use, it can become unwieldy for complex productions, in spite of the scrolling and zoom features.

AimTech offers a runtime module for \$50 per copy, which means you can distribute your productions to others without having to provide a full copy of *IconAuthor* for each playback computer.

*IconAuthor*, like the other packages reviewed here, is not well suited for the casual presentation developer; the commitment in time and money makes it more appropriate for those who spend a lot of time creating multimedia productions. It is not as strong in its support for Multimedia Windows as the other programs in this review, but if you intend to use video in your productions, *IconAuthor* is the clear leader.

## Multimedia ToolBook

Asymetrix Corp. is perhaps best known for *DayBook*, the personal organizer bundled with Microsoft Windows 3.0, but those in the know are aware that the *DayBook* program was developed using Asymetrix's authoring product, *ToolBook*. *ToolBook* is fundamentally a high-level, Windows-based programming environment similar to Apple Computer's *HyperCard*; *ToolBook* has been the tool of choice for many who create hypertext-like documents.

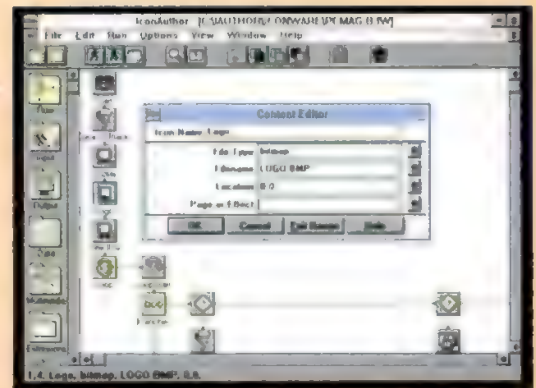
Other Windows packages, such as Oracle Corp.'s *Oracle Card* and Spinnaker's *Plus* for Windows 3.0, Ver-

## MULTIMEDIA AUTHORING: A Look Behind the Scenes

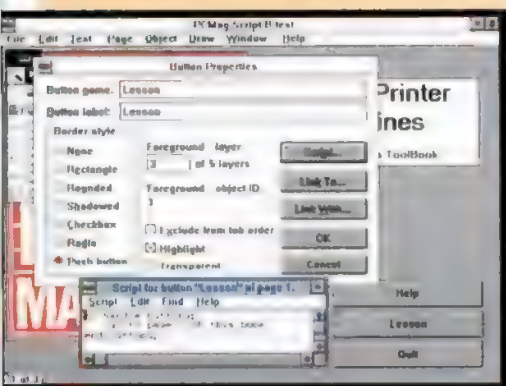
The end user of multimedia views the results of some powerful creation tools. Here's a glimpse at how the three multimedia packages reviewed in this issue work behind the scenes to assemble a presentation.

*IconAuthor* has an icon-based development interface. The icons represent the flow of the presentation. You can label individual icons with meaningful

names; in this case, a Display icon has been renamed Logo. As shown in its Content Editor dialog box, this icon displays the bitmapped image file LOGO.BMP. Page or Effect options specify transition effects describing the way an image is drawn on the screen.

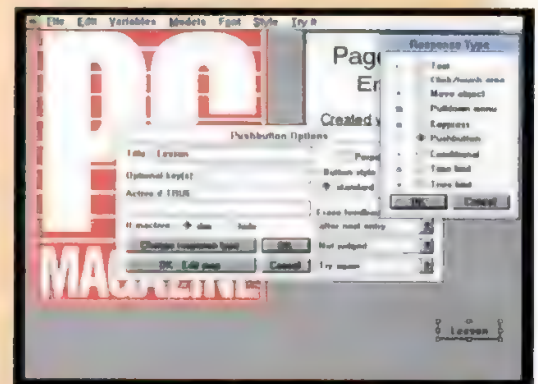


*Authorware Professional for Windows* also uses an icon-based paradigm to show the flow of a presentation. The package excels at incorporating user interaction. Here, the Lesson button was created by adding an Interaction icon, which makes it possible to add icons to the presentation that will accept user responses, resulting in branches in the presentation. Note the many different types of responses you can select in the dialog box at the upper right of this screen.



*Multimedia ToolBook* pages can contain objects that trigger events. This

screen shows the properties that have been assigned to the Lesson button. The window at the bottom of the screen shows the simple OpenScript program instructions that will cause the presentation to jump to the third page of the book when the user clicks on the Lesson button.





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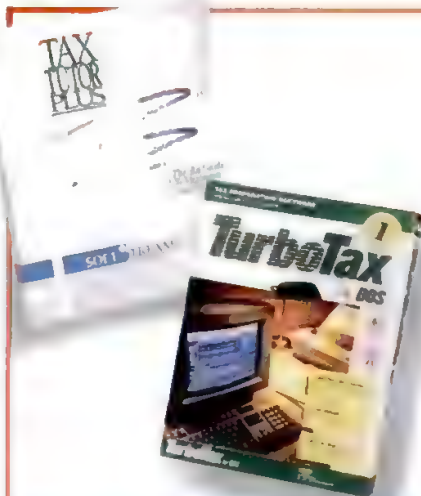
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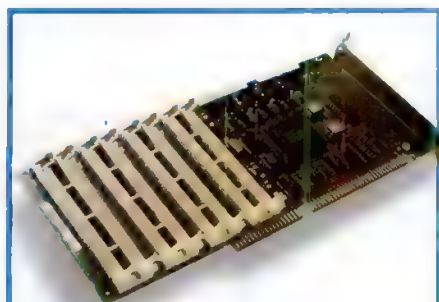
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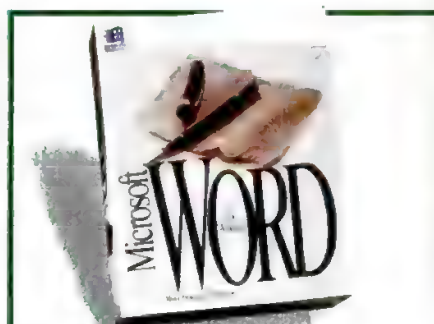
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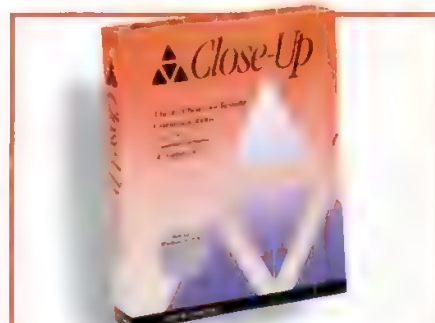
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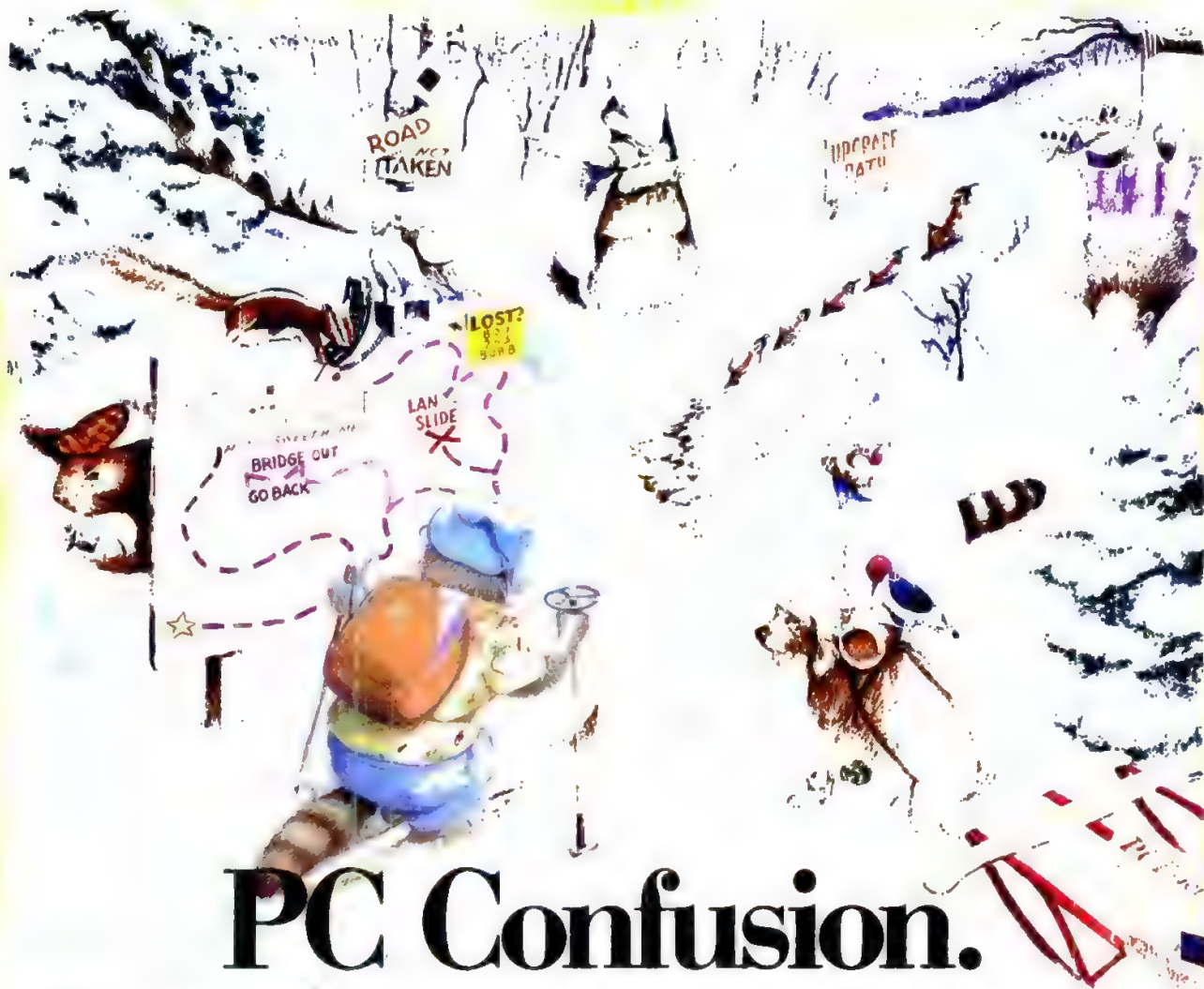
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## MULTIMEDIA

### Authoring Software

can's Power Programming columns in our issues of December 11 and December 25, 1990.) The basic concept is: You draw various objects on the screen, then create the underlying "scripts" that will cause one or more results when a given object is somehow selected or triggered. These scripts are actually small programs written in OpenScript, *ToolBook's* programming language.

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Since most productions require more than a single screen, *Multimedia ToolBook* needs another level of organization; it uses a book metaphor. Each screen is described as a *page*; all the pages in a production are called a *book*. Within each page, you can have objects on multiple levels, which are further divided into the foreground and background. The background layers are handy when you want to create a series of pages (screens) that share some common elements, such as an image or command buttons like Next or Quit.

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Once you have developed your production, you can easily make copies and distribute them. Asymetrix includes a free



#### Multimedia ToolBook

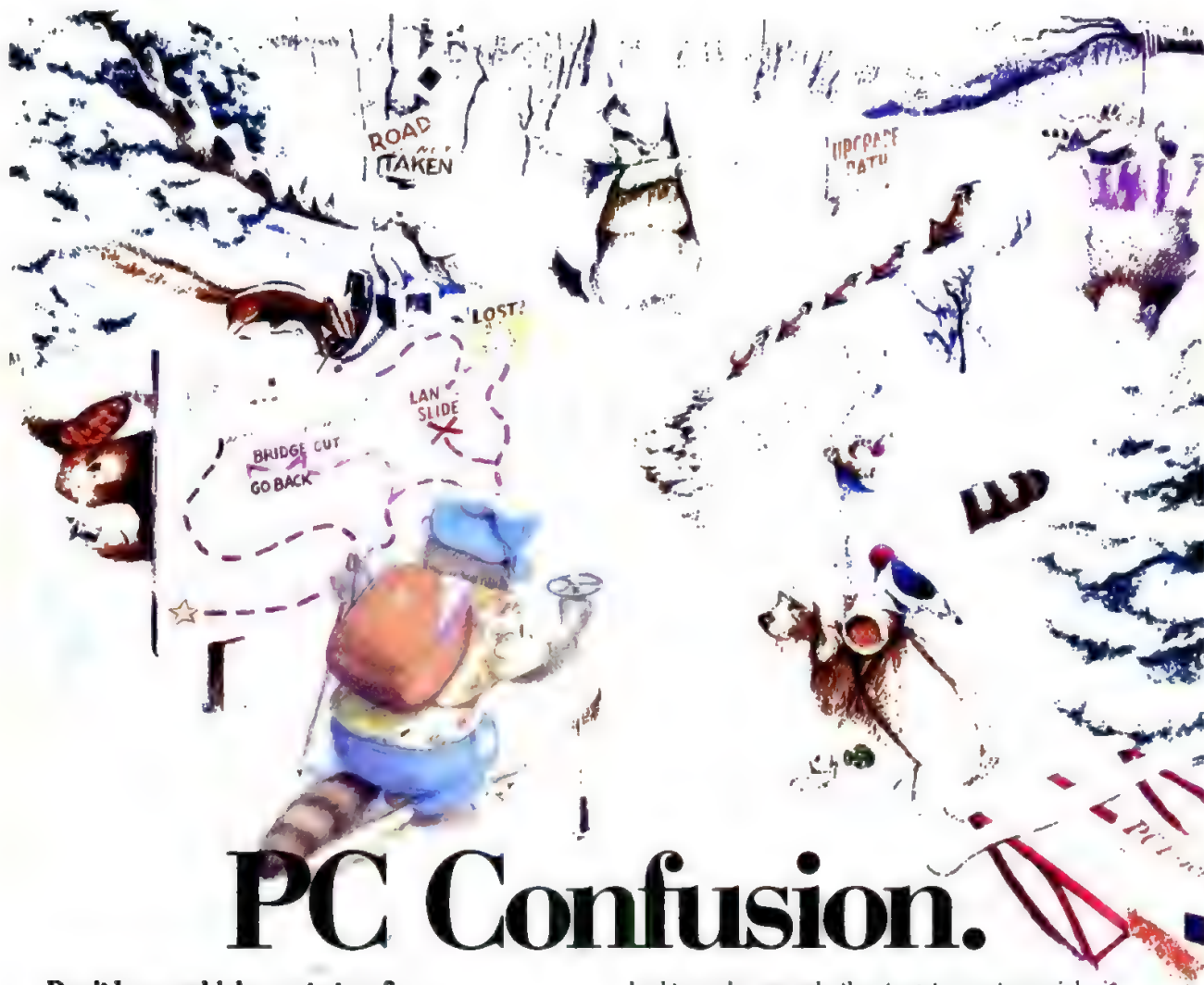
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**Requires:** 386-based PC or better; 2MB RAM (3MB recommended); 6MB hard disk space; VGA or Super VGA adapter and monitor; Microsoft Windows with Multimedia Extensions 1.0; mouse or other Windows-compatible pointing device; CD-ROM drive.

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CIRCLE 470 ON READER SERVICE CARD





Windows runtime package, which you may include with your productions without paying any royalty to Asymetrix. *Multimedia ToolBook* has an additional advantage in this area in that you can apply password protection to the productions at two levels: One level limits access to viewing the production, while the other limits access to editing it. Neither of the other programs in this review has any built-in security features.

Beyond the need to learn OpenScript, another reason *Multimedia ToolBook* is difficult to master is that the documentation is disorganized. The package comes with the full documentation for the original version, including a 400-page general reference and a 600-page OpenScript manual, plus a 90-page set of upgrade notes for Version 1.5. The Multimedia additions are covered in a separate 85-page reference, with another 6 pages of release notes. As a result, you can end up looking in four or more places at a time as you try to make a particular feature work the way you want.

Yet another problem is that *ToolBook* is slow, although Version 1.5 has markedly better performance than Version 1.0. Even on a 386/25 system, there are noticeable lags between a user's response and the application's reaction. The sample tutorial is particularly soporific, which is unfortunate since this should be an application where the program shows its best stuff.

*Multimedia ToolBook* has plenty of flexibility, if you are willing to invest the time to master its tools. Applications development takes time, and the result tends to run slower than competing packages' productions. On the other hand, the low cost, royalty-free runtime, and hypermedia features are strengths that will appeal to some users.

Charles Petzold and Alfred Poor are contributing editors of PC Magazine.

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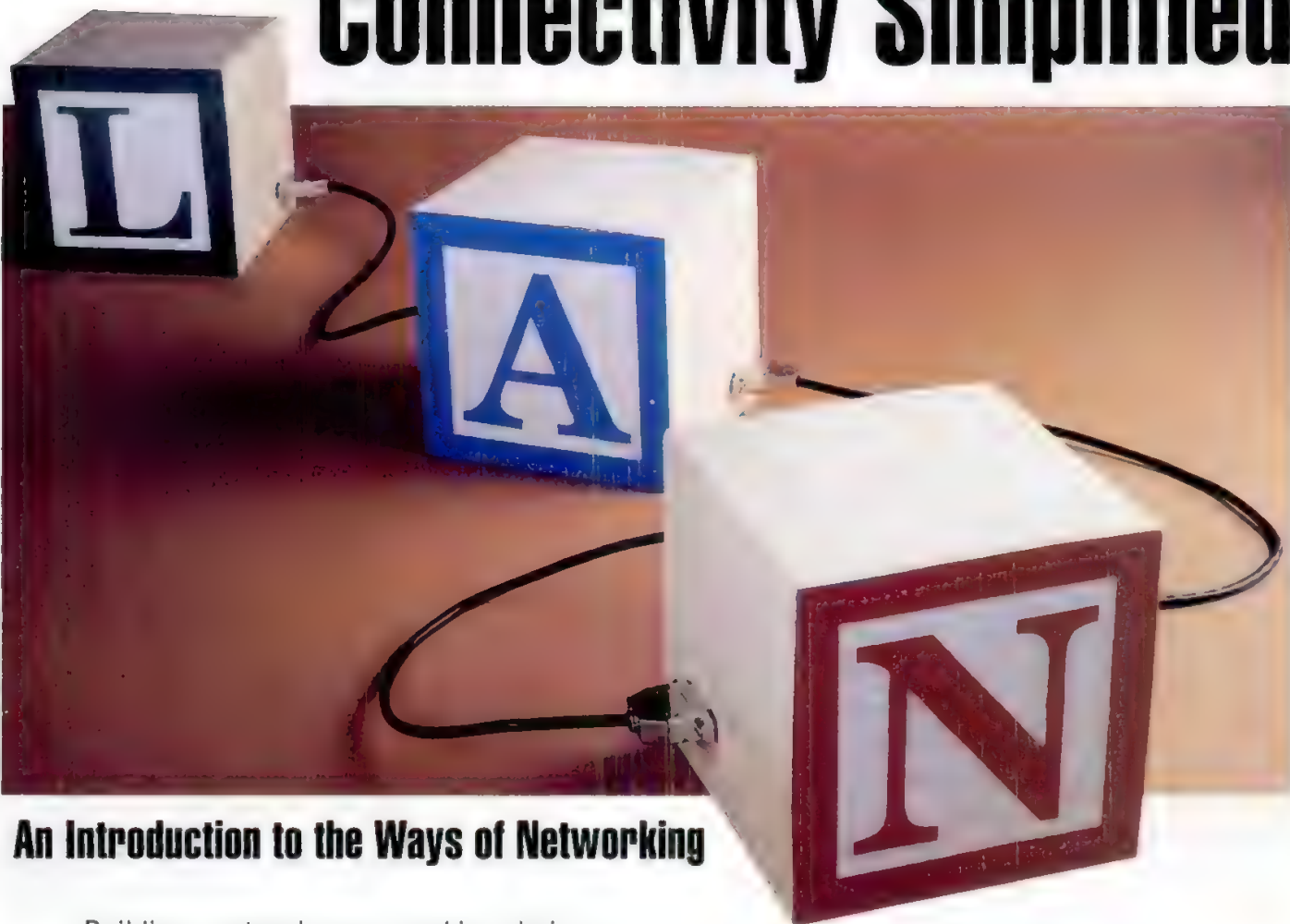
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CIRCLE 021 ON READER SERVICE CARD

# Connectivity Simplified



## An Introduction to the Ways of Networking

Building a network means making choices.

This overview explains the different options available for connecting the computers in your office.

From printer sharing to network operating systems,

we will tell you what the jargon means,

how much the products cost,

and what your best choice is.

**by Frank J. Derfler, Jr.**

Nowadays the question is not *whether* to network your computers, but *how*. Local area networks (LANs) are a powerful choice but typically require you to invest thousands of dollars. Other options include peripheral-sharing devices, file-transfer software, and zero-slot LANs; these are more economical but lack the sophisticated capabilities of a LAN. And with dozens of products to choose from, where do you begin?

Here is the first of a two-part series on LAN fundamentals. In this issue, we look at the options, strategies, and products you can use to connect computers. We do



not list every product in every category, but we will cut through the vendor hype and explain which options are available and how to take advantage of them. And to speed your way to a better networking understanding, we have italicized key terms. In the next issue, we will look at low-cost LANs. More expensive LANs like *NetWare*, *VINES*, and *Lan Manager* will be covered in a subsequent issue.

There are five different methods of connecting PCs:

- printer-sharing devices;
- file-transfer software;
- zero-slot LANs;
- DOS-based network operating systems;
- non-DOS-based network operating systems.

With all of these methods, a basic rule of physics applies: You can have a fast, long, or inexpensive connection; pick any two. Parallel connections can move data at around 400 to 1,200 kilobits per second (Kbps), but only for about 30 feet. Serial cables can handle signaling speeds as fast as 38.4 Kbps for distances of over 100 feet. LANs can have signaling speeds far faster. And the higher speeds naturally bring higher costs.

Although signaling speed is important, the real criterion is throughput. Throughput is the amount of data that is passed over a wire, excluding overhead. Since throughput varies according to factors such as the CPU speed in individual machines, it is difficult to measure. As a rule, you will get greater throughput from a network that runs at a higher speed. But there are instances where that rule may not apply, as when comparing an *Ethernet* network running at 10 Mbps (megabits per second) and carrying a lot of network traffic with a lightly loaded *Token-Ring* network running at 4 Mbps. (See the sidebar "Comparing Signaling Speed and Throughput.")

*Printer-sharing devices* and *zero-slot LANs* are a good choice when connecting printers is all that is needed. These simple devices inexpensively link two or more PCs via a serial or parallel port (reported in "Buffered Printer-Sharing Devices," *PC Magazine*, April 30, 1991).

If sharing files is important, look at *file-transfer products* (examined in "File-Transfer Software," March 12, 1991). New developments will allow them to transfer files across the emerging digital telephone technology, Integrated Services Digital Network (ISDN).

## HIGHLIGHTS

DOS-based LANs are well suited for connecting networks of up to 50 users at roughly \$350 per user. For networks that need consistent high-quality performance and LAN-to-LAN connectivity, consider a non-DOS-based LAN. They typically cost between \$500 and \$1,000 per node; prices drop as the number of users increases.

If IBM connectivity is important, buy Token-Ring adapters. Otherwise stick with Ethernet.

If you run unshielded twisted-pair (UTP) cabling to the desktop, back it up with dark fiber (unused fiber-optic cable). If you run shielded twisted-pair (STP) wire, you do not need dark

fiber. If you are connecting separate floors or buildings, use fiber.

Try to find a single source that will integrate the products together in a network instead of trying to integrate disparate components.

A single midrange PC, such as a 16-MHz 386SX, has just over 1 Mbps of effective throughput on any network.

Unless you are only connecting a few PCs, wire a workgroup in a star topology around a wiring center with management capabilities.

Don't be fooled by high signaling speed numbers. The real criterion is throughput: the amount of actual data that is passed over a wire, excluding overhead.

Picking a LAN is difficult, but there is some help. If you plan to put less than 50 users on your network (that number is a soft guideline) and if you do not need many full-time LAN-to-LAN links, then evaluate individual *DOS-based LAN products* for features, capabilities, and price. We will review DOS-based LANs in an upcoming issue of *PC Magazine*.

If your network will have 100 or more nodes that all need complicated database access and if it will have a lot of LAN-to-LAN connectivity, however, then consider a *non-DOS-based LAN* like *NetWare*, *VINES*, or *Lan Manager*. Support is an important factor in selecting non-DOS-based network operating systems. You will need training and help with installation, so look for products with good local support. In either case you can save some heartache by purchasing your products from a single source.

Cabling should offer enough capacity to support future bandwidth demands. Unshielded twisted-pair (UTP) wiring is a cheap solution; fiber-optic cabling offers high quality at a high price.

Bridges and routers connect several networks. Bridges offer quick and "dirty" links, while routers provide top-notch security and reliability to a group of networks.

Now here is more detail on DOS-based

network operating systems and non-DOS-based network operating systems.

### REAL LANs

Simple printer- and file-sharing devices provide all the connectivity that some organizations need. But when your network grows beyond a few nodes, when you need high-speed file access, or when you want to use electronic mail, scheduling software, and other workgroup applications, then you need a real LAN.

A real LAN, in our broad definition, uses network adapters that employ special techniques to share a common medium (such as a cable or a radio or light wave) between the connected computers. A LAN also uses some type of software to deal with simultaneous requests for service from many client stations. Sharing common cabling and pooling resources within a workgroup are the key elements of LAN operation.

An important fact to remember about LANs is that they do not have to break your bank book. There are still low-cost networks based on DOS, such as *LANtastic*, *NetWare Lite*, or *POWERlan*, that use high-speed LAN links to share files among two or more PCs and that offer flexible printer sharing. For more powerful functionality there are non-DOS-based networks. Network applications aside, the





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| 07207 Borland Objectvision 2 0    | 89                               |    |
| 07206 Screenery for Win           | 28                               |    |
| 07327 Turbo C++ 2nd Ed for Win    | 109                              |    |
| 09179 Turbo Pascal for Windows    | 129                              |    |
| <b>Caera Corporation</b>          |                                  |    |
| 09139 Omnipage 386 V3 0 for Win   | 469                              |    |
| 09785 Omnipage Pro 386 2 0 Win    | 699                              |    |
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| 08642 Corel Draw 2.0              | 368                              |    |
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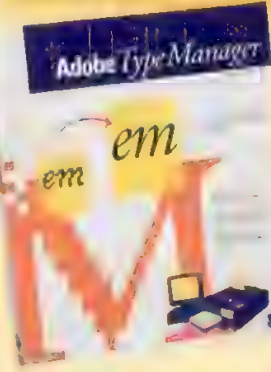
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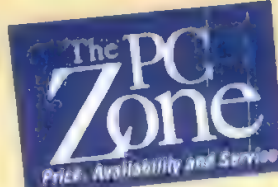
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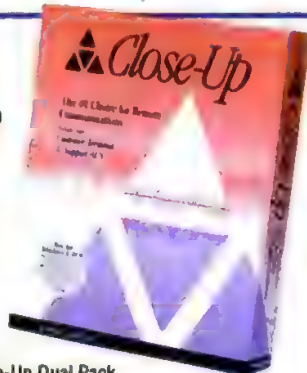
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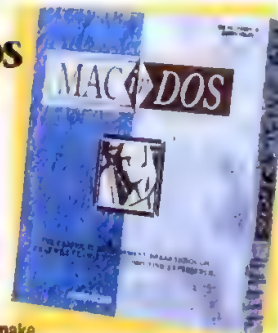
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## STRUCTURING THE NETWORK

Star-wired networks are built around a wiring hub or concentrator, unlike the linear arrangement of a bus topology. In both Ethernet and Token-Ring networks, the wiring hub sits at the center and is connected by unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cabling to both internal and external LAN adapters sitting inside PCs or laptops. Several wiring hubs can be connected by fiber-optic cabling.

File and print server with MCA or EISA LAN adapter

Fiber-optic cable connects to other hubs

Wiring hub

UTP cabling

Shared printer

Telephone line

Modem with internal LAN adapter

Shared printer

Client PC with ISA LAN adapter

Client PC and print server with ISA LAN adapter

Client laptop PC with external LAN adapter

### STAR-WIRED NETWORK

Coaxial bus

Coaxial cabling

Client PC with network adapter

Client PC and print server with network adapter

File and print server with MCA or EISA LAN adapter

Shared printer

Shared printer

### BUS TOPOLOGY

subject of local area networks breaks cleanly into four sections:

- Cabling: the connections between the nodes (computers);
- Adapter cards: the connections between the PCs and the cabling;
- Network operating systems: the software link between the LAN adapter and the PC (network operating systems consist of protocols);
- Off-LAN communications: connections to the rest of the world.

These topics are interrelated, yet separate. Adapter cards typically work with many types of wiring, network operating systems drive many different adapters, communications protocols carry data to many different types of network operating systems, and the off-LAN communi-

cations and applications programs run over many different protocols. Modern LANs provide a rich menu of choices.

With so many different components, the major cost of a LAN may be more from troubleshooting than from the price of specific products. One way to trim this cost is to purchase your networking products from a single source. Whether that source is a value-added reseller (VAR) or a vendor, be sure there is one place where you can get all of your networking questions answered.

#### CABLING: A CRITICAL FACTOR

The larger the area your LAN covers, the more the cabling becomes a critical design factor. First, determine if cabling will drive your network budget and

planning cycles or if it will be a minor consideration. The type of cabling you already have installed or that you want to use might be a major decision factor in the design and layout of your network, or it might be a minor factor that you can handle quickly. (See the pullout "Network Cabling Guide: Building a Reliable Infrastructure.")

Your cabling choices are far from simple: voice-grade UTP (10 cents per foot), data-grade UTP (12 cents per foot), shielded twisted-pair (44 cents per foot), coaxial cable (25 cents per foot), fiber-optic cable (\$1 per foot), and no wiring at all.

Each type of cabling has its advantages and disadvantages. Most UTP is cheap and easy to install. Data-grade UTP also has a large enough bandwidth to grow with future technologies. But the vast majority of UTP installed for telephone systems is voice-grade; it is limited in bandwidth, and might restrict future growth.

Shielded twisted-pair (STP) is UTP with shielding to protect the wiring from electromagnetic interference (EMI). STP offers better immunity to noise than data-grade UTP, so carrying high data rates is more practical on STP than on data-grade UTP. The drawbacks to STP are that it



## GLOSSARY

**CMIP (Common Management Information Protocol)** A protocol adopted by the ISO that defines how management information can be communicated between stations.

**dedicated server** A server that performs specialized network tasks, such as storing files. Users do not rely on dedicated servers as local stations. Nondedicated servers also contribute resources for network tasks but can act as efficient local stations for users. Nondedicated servers function well if demands from other stations are relatively infrequent.

**Ethernet** A network cabling and signaling scheme with a 10-Mbps rate that works over a wide variety of cabling. The IEEE 802.3 standard can be used interchangeably with Ethernet, but there are some subtle differences between the two. Be sure that the products you buy really do offer 802.3 or Ethernet support.

**file server** A computer used to store files for access by client stations.

**hub** A type of wiring center that serves as the meeting point in a star wiring arrangement. Both wiring hubs and concentrators are useful for their centralized management capabilities and for their ability to isolate nodes from disruption. The terms may have different meanings in different contexts. When we refer to a wiring hub, we mean a product that only supports Ethernet, Token-Ring, or FDDI. A concentrator may support all or combinations of these three.

**IEEE (Institute of Electrical and Electronics Engineers)** An organization whose committees define standards for network cabling schemes. The IEEE is affiliated with the International Standards Organization (ISO). If you work for a government agency, your networking equipment probably needs to conform to IEEE standards.

**IPX/SPX (Internetwork Packet Exchange/Sequenced Packet Exchange)** Two network protocols. IPX is a *NetWare* protocol for moving information across the network; SPX works on top of IPX and adds extra commands. In the OSI model, IPX conforms to the network layer and SPX is the transport layer.

**ISO (International Standards Organization)** A worldwide body that defines standards for communications, such as the OSI model.

**megabit** Just over one million bits (binary digits, 0 or 1) of data. Megabit can describe the amount of information moving across a network link, particularly over a given period of time, as in megabits per second.

**micron** A unit of measurement corresponding to  $1/25,000$  of an inch. A micron can be used to specify the core diameter of fiber-optic network cabling. This diameter should match your hardware vendor's requirements; but if you install fiber before you buy the equipment, specify the 62.5-micron size.

**NDIS (Network Driver Interface Specification)** The device driver standard created by Microsoft and 3Com, supported by many network card vendors. NDIS helps ensure compatibility with many network operating systems. Conceptually similar to ODI.

**NetBIOS (Network Basic Input/Output System)** A transport protocol connecting network hardware with the network operating system. There are a variety of NetBIOS implementations, many which do not work together.

**Network Interface Card (NIC)** The attachment that connects a device to a network. The NIC, usually a PC expansion board, executes the code needed by the connected device to share a cable or some other media with other stations. If I/O is an issue, you should

invest in bus-mastering adapters.

**ODI (Open Data-link Interface)** A device driver standard from Novell. ODI allows you to run multiple protocols on the same network adapter card. Not yet as widely supported as NDIS.

**OSI model (Open Systems Interconnection model)** A seven-layer model developed by the ISO that describes how a terminal and computer communicate. The OSI model comprises the physical layer, data-link layer, network layer, transport layer, session layer, presentation layer, and application layer. Adherence to the OSI model provides a foundation for different vendors' products to interoperate.

**peer-to-peer** A network architecture where a user's PC doubles as a server, rather than accessing centralized file or print servers. Most DOS-based LANs are peer to peer. While peer-to-peer resource sharing is effective in small networks, security and reliability issues prevent its widespread use in larger networks.

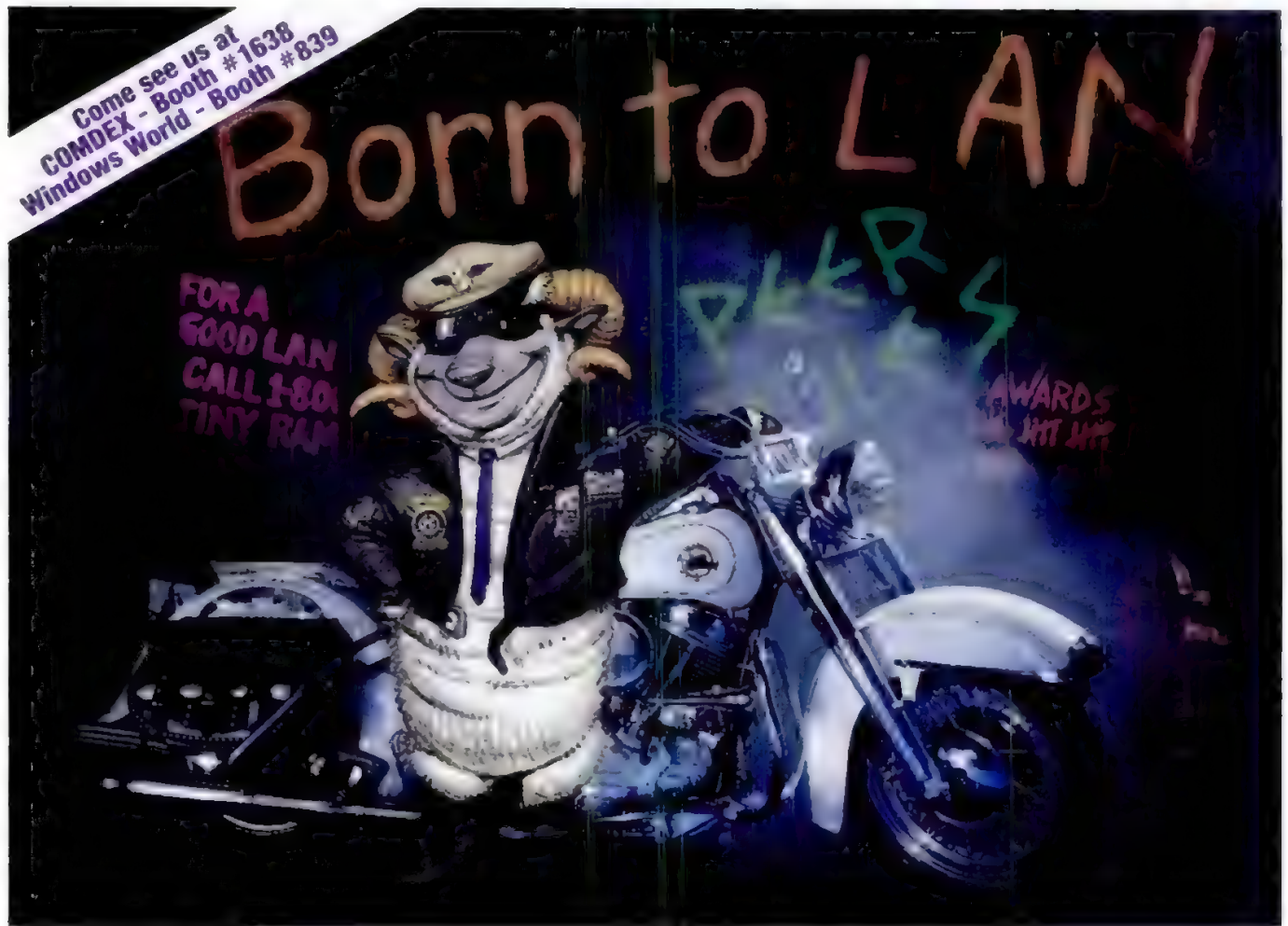
**SNMP (Simple Network Management Protocol)** A control and reporting scheme widely used to manage devices from different vendors. SNMP operates on top of the Internet Protocol, and is similar in concept to IBM's NetView and ISO's CMIP.

**TCP/IP (Transmission Control Protocol/Internet Protocol)** A set of protocols developed by the Department of Defense and supported on many computer platforms.

**Token-Ring** A signaling scheme where a special message, passed from node to node, gives a node permission to enter a message or frame into the ring. Popularized by IBM, a Token-Ring network is a good choice for connecting PCs and mainframes. The IEEE 802.5 standard defines Token-Ring networks. ■



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carries a high price and is clumsy to use.

Similar problems exist with coaxial cable. Coaxial cable for networks, known as Ethernet trunk cable, comes in both a thick and a thin version. The thick version is expensive and is specific to Ethernet. The thin version is cheaper and easier to work with, but it is subject to a greater chance of data loss over long spans of cable.

Fiber-optic cabling is the most expensive cabling around. Yet fiber provides a tremendous amount of bandwidth, security, flexibility, and reliability.

Our advice about wiring is clear. First, if you have a large installation, consider using fiber between wiring closets in the building and around the campus, regardless of what cabling you run between the wiring closets and the desktops.

Second, if you are planning a new building or doing a major rewiring and you install UTP wire, then pull as much fiber as possible; the fiber can sit until needed. Since much of fiber's cost lies in the installation fees, it's usually cheaper

to pull fiber with new copper cabling than to pull it separately. And if you install only UTP today, the computers and applications you will want to use in five years will probably force you to invest more money in cable. But with coaxial cable or STP wiring at each desktop, fiber is not needed.

If installing a cabling plant sounds scary, you might look into wireless LANs. But beware: The term *wireless* is misleading. Most

wireless LANs are not totally wireless (reported in "Portable, Affordable, Secure: Wireless LANs," February 11, 1992). They usually need a cable to connect a PC or some other network device to the wireless transmitter.

It is difficult to categorize wireless LAN systems because there are so many different architectures available. Some products only work with Ethernet or Token-Ring cabling; others replace the cabling on certain segments. For example, the Altair system, from Motorola (800-

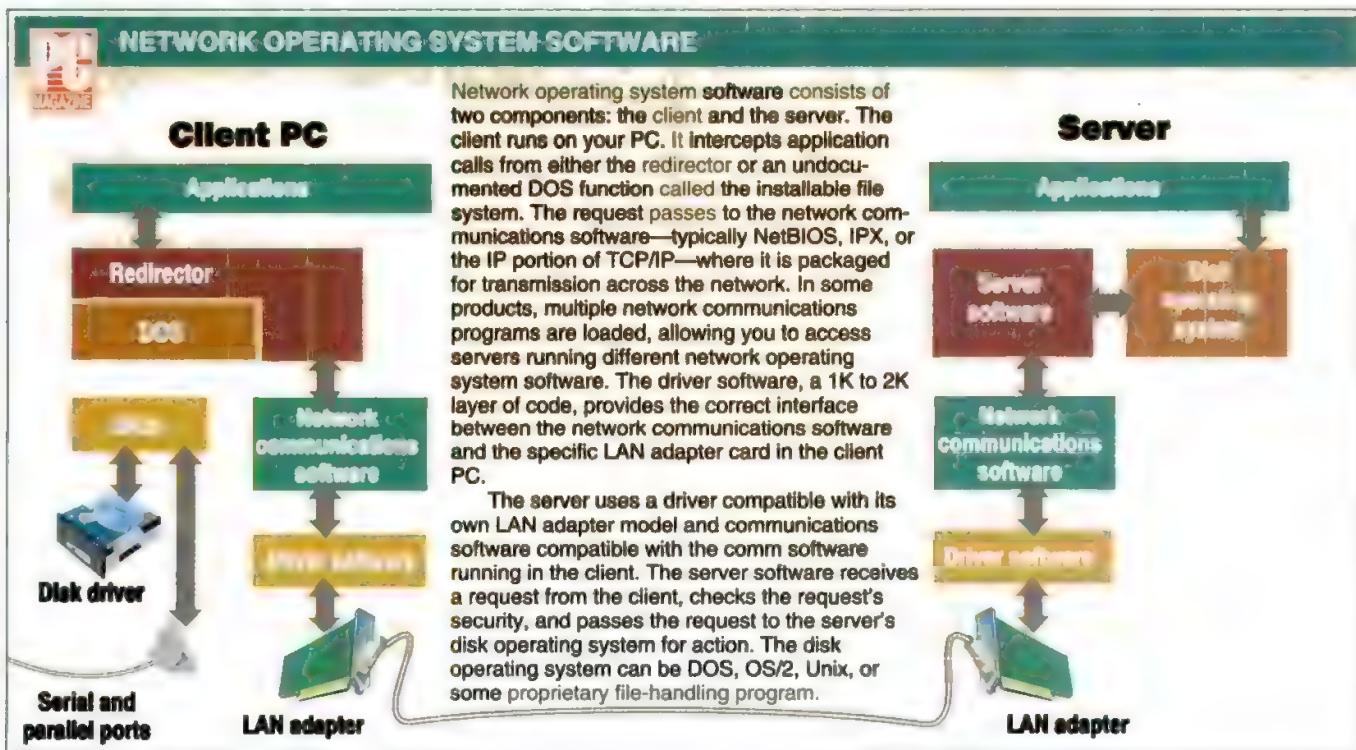
233-0877), links workgroups in Ethernet-cabled networks. Winner of a 1991 *PC Magazine* Award for Technical Excellence, the Altair costs \$4,990 for the first two LAN segments. The WaveLAN system, from NCR Corp. (800-225-5627), uses \$995 LAN adapters that function as UHF radio transceivers in each PC. Like the Altair, the WaveLAN can link LAN segments, but WaveLAN can also link individual PCs together. WaveLAN works with both Ethernet and Token-Ring networks.

While the Altair and the WaveLAN use radio waves to link networks segments, InfraLAN, from BICC Communications (508-832-8650), connects Token-Ring LAN segments using infrared light. InfraLAN costs \$2,995 per device and you need two to get started.

#### LAN ADAPTERS

Regardless of the cabling used, PCs attach to the network via a LAN adapter. LAN adapters, also called *network adapters* or *network interface cards (NICs)*, perform two functions. First, they translate between the low-powered signals moving over your PC's expansion bus and the more robust signals moving over the network media. Second, LAN adapters run the software that describes how the adapters use the LAN wiring, also called the *media-access control (MAC)* protocol. The MAC protocol also specifies the type

**F**iber-optic cabling is expensive, but it provides a tremendous amount of bandwidth, flexibility, reliability and security.





of signals sent over the wiring.

Network adapters connect to a PC on one side and to the network on the other side. Most slide into the PC and connect via the PC's expansion bus. But some vendors have introduced external network adapters that connect through the parallel port, which allows you to connect laptops and other PCs to the network easily.

On the LAN side, there is a host of alternatives, including ARCnet, Ethernet, Token-Ring, and FDDI (Fiber Distributed Data Interface), all supporting different cabling types.

You must understand your needs before you can choose among these networking types, but here is one recommen-



**You must understand your needs before you can choose among these networking types.**

dation: Be wary of ARCnet. Once very popular and still present in a number of installations, ARCnet is dwindling in sales. Unless the installed cabling system only

supports ARCnet, future plans should be oriented around one of the standard specifications set out by the Institute of Electrical and Electronics Engineers (IEEE) or the American National Standards Institute (ANSI): Ethernet, Token-Ring, and FDDI.

The electrical circuitry and connectors on the adapter determine what kind of cable the LAN uses. The adapter that you buy will be designed specifically for UTP wiring, coaxial cabling, or one of the other

LAN wiring schemes. And some adapters offer connections for more than one type of cabling. Several companies deliver Ethernet adapters for either UTP or coaxial connections.

If you already have an investment in the adapters and you want to change the wiring, however, you can usually add an external device called a *transceiver*. A transceiver translates, for example, between a LAN adapter designed for coaxial cable and the installed UTP wire or fiber-optic cable.

On Ethernet adapters, the connection between the adapter and the transceiver is usually made using the attachment unit interface (AUI) port, a 15-pin socket for special connection devices.

Similar to the transceiver, a device called a *media filter* operates under the same general principles in Token-Ring networks. A media filter will cost you around \$50; transceiver prices range from \$40 to \$250 for copper-cable systems and

## CABLING GLOSSARY

**attenuation** Signal loss over distance. Cables are not perfect carriers of signals; the signal diminishes over distance. The best cables (those with the least attenuation) are fiber-optic lines, and the worst cables are unshielded, untwisted-pair lines, such as the silver "flat satin" cables used in short-run phone and modem lines.

**AUI (Attachment Unit Interface)** A 15-pin socket used in some Ethernet devices. AUI connections adapt between two cabling types and work with a wide variety of wiring schemes.

**bandwidth** The amount of data a line can carry. Bandwidth is measured either in bits per second (for digital transmission signals) or in hertz (for analog transmission signals such as electrical waves). Greater bandwidth means greater data transmission capability.

**capacitance** The ability of a dielectric (nonconductive) material, such as that in coaxial cable, to store electricity. Capacitance exists when there is a difference between the voltage passing through two conductors separated by the dielectric.

**crosstalk** Interference generated when magnetic fields interrupt electrical currents. When an electrical current travels through a wire, a magnetic field is generated around that wire. If several wires are close together, the magnetic fields interfere with the electrical currents of neighboring wires (and therefore the signal). Crosstalk is eliminated by shielding and by periodically twisting pairs of wires around each other. When the wires are twisted, the magnetic fields generated can cancel each other out to a great extent.

**Ethernet** A network protocol based on collision detection. In its modern form, Ethernet is compatible with IEEE 802.3, which standardizes a signaling rate of 10 Mbps over a variety of cabling schemes.

The IEEE 802.3 standard also governs such matters as cable lengths, terminators, and connectors. UTP cabling in a star configuration with a wiring hub is IEEE-standard 10BaseT; coaxial or fiber-optic cable also works well in a star configuration. Cabling for Ethernet networks is installed in a station-to-station star pattern, with a T-connector at each PC, a minimum cable length of

3 feet between connectors, and a terminator at each end of the cable. The maximum length of the coaxial cable between any two nodes is 1,000 feet, with up to 100 nodes on a segment. Ethernet segments can be linked together with repeaters, for a maximum length of 5,000 feet for the overall system cable.

**FDDI** (Fiber Distributed Data Interface) American National Standards Institute (ANSI) specification X3T9.5 for transmission at 100 Mbps over fiber-optic cable in a ring configuration. LANs using fiber do not necessarily conform to the FDDI specification. Actions are underway to extend the specifications to copper STP and UTP wiring as CDDI. Due to the high cost of FDDI LAN adapters, CDDI will probably link desktops to FDDI-equipped wiring centers.

**gauge** A measurement of physical size for cabling. Under the American Wire Gauge (AWG) standards, higher numbers indicate a thinner cable.

**impedance** The amount of opposition the electrical current encounters while transversing the wire. Impedance is



hover just under \$500 for fiber.

On the expansion bus side, you must choose an adapter compatible with the architecture of your PC. Cards are designed for ISA (Industry Standard Architecture), MCA (Micro Channel architecture), or EISA (Extended Industry Standard Architecture) bus systems in 8-, 16-, and 32-bit versions. In addition, you can choose adapters with bus mastering; these adapters use special circuitry to take control of the PC's expansion bus, thus relieving the PC's CPU of the burden of servicing interrupts.



**Consider purchasing 8-bit adapters for your client PCs, but on file servers, I/O speed is critical. Spend money for 16- or 32-bit cards.**

If cost is the issue and your computing needs are not going to change significantly, consider purchasing an 8-bit adapter for client PCs. Many client PCs do not need the additional throughput of a 16-bit adapter that costs \$40 to \$50 more than an 8-bit adapter.

If that adapter is connecting a *file server*, however, input/output (I/O) performance is critical. In this case, spend the money on a 16- or even a 32-bit bus-mastering adapter. Bus-mastering adapters free the CPU to run data-hand-

dling routines without processing frequent interruptions by the LAN adapter.

If you want easy installation and connection, look at an external LAN adapter (reviewed in "External Token-Ring Adapters: Plug and Play—and Pay?" January 14, 1992). These products are available for both Ethernet and Token-Ring networks from vendors such as Accton Technology Corp. (510-226-9800), IQ Technologies (206-483-3555), Megahertz Corp. (801-272-6000), and Xircom (818-878-7600).

External adapters tend to be more expensive than internal adapters. For example, Xircom's 4Mb/16Mb External Token Ring Adapter carries a \$945 price tag and its Ethernet adapter costs \$595. In addition, the throughput of an external adapter is currently only 30 percent that of an internal adapter. This is due to the relatively slow speed of the parallel port.

Help may be on the way. A new enhanced parallel port (EPP) specification

roughly equivalent to friction and is a factor in signal diminishment, or attenuation.

**media filter** A device for converting the output signal of a Token-Ring adapter board to work with a certain type of wiring. Media filters can be used, for example, to link 16-Mbps Token-Ring LAN cards with UTP wire. They can save you the expense of installing extra wiring runs.

**plenum cabling** Cabling with a fire-resistant coating. There are generally two types of outer coverings (casings) used for cables: PVC (polyvinyl chloride) and a fire-resistant material, in practice usually a Teflon coating. PVC is common and low in cost but gives off poisonous smoke and fumes when it burns. When shopping for cabling to use within walls, between floors, or in suspended ceilings, make sure you buy cables meeting the CMR (Communications Riser Cable) or CMP (Communications Plenum Cable) specifications of the National Electric Code.

**signal-to-noise ratio (SNR)** The ratio between the amounts of desired signal

and undesired noise at some point in the cable. It is different for every cable in every installation and is particularly important in installations of UTP wiring. The SNR measurement can be used to verify whether your cabling will work in a specific LAN system. SNR specifications for Token-Ring are much more rigid than those for 10BaseT Ethernet or ARCnet. Devices such as Microtest's Next Scanner can examine each cable pair, determine the SNR, and make recommendations for the cable's use.

**Token-Ring** A deterministic network protocol based on collision avoidance. Token-Ring, also known as IEEE 802.5, is a protocol for signaling at 4 or 16 Mbps over STP, UTP, or fiber-optic cabling. Token-Ring cabling is always laid in a star configuration with a wiring hub. Messages called *tokens* are relayed from one active computer to another, and the wiring center switches a station into the ring only when that station runs the networking software to activate its LAN adapter. As more stations activate, the overall length of the wiring system expands rapidly; cable system limitations are based on the number of active stations and the amount of ca-

bling between each station and the wiring center.

Manufacturer recommendations for the maximum distances of adapters and wiring centers vary widely. Some conservative numbers for 4-Mbps Token-Ring over STP are a maximum of 96 stations, each with a maximum cable length of 150 feet, and a maximum distance between wiring centers of 400 feet. But on networks with only a dozen nodes, you can push each station's cable distance out to over 300 feet using 16-Mbps signaling over UTP.

**transceiver** A telecommunications device capable of sending and receiving information. In networking, transceivers convert between an AUI Ethernet connection and some other cabling type, such as fiber, coaxial, or UTP. Transceivers may be located on an adapter card or sold separately as external devices.



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unveiled by Intel Corp., Xircom, and Zenith Data Systems in 1991 boosts speeds as high as 16 Mbps in bursts. This is approximately 30 times as fast as the present parallel-port speed of a PC; in practice, you may see parallel-port speed approach three-quarters that of internal adapter—if you have the hardware. Today, the EPP hardware can be found in laptops based on the Intel 25-MHz SL chip set, which began shipping in the first quarter of 1992.

#### NETWORK ADAPTERS

Until the past few years, the terms Ethernet, Token-Ring, and FDDI each encompassed a family of products, including specific types of wiring, connectors, network communications software, and adapter cards. But the products within these families have evolved beyond the original definitions. Now, for all practical purposes, the terms primarily define the MAC protocol and the type of signals sent over the wiring.

All three of these protocols use packet-based technology. A packet, or frame, is a message that contains the addresses of the sending station and the receiving station, among other things. The adapter transmits the packet onto the network, where it travels to the network adapter with the appropriate destination address. The particular protocol determines the size of the packet, how it travels across the network, and how the stations decide who can transmit a packet.

The chip sets on the network adapters typically run one of these protocols. But recently, a number of vendors, including Texas Instruments, have begun researching chip sets that will run more than one protocol. C&T is the first vendor to develop such a chip set, called ChipsLAN. Over the long term, such chip sets will be used as LAN adapters built into PCs. This configuration will make it easier and less expensive to put a PC on a LAN. But in the short term, you should see many bridge and router vendors incorporating the chip set into their designs.

**T**he terms *Ethernet, Token-Ring, and FDDI* used to encompass whole families of products; now they primarily indicate MAC protocols and signal types.

## COMPARING SIGNALING SPEED AND THROUGHPUT

by Michael Cohn

Signaling speed and throughput can differ widely. Signaling speed is the theoretical maximum rate at which data can be transmitted, while throughput measures the actual amount of information carried. This chart compares signaling speed and throughput for many types of equipment. But because throughput depends on many factors, the ranges given here are approximate.

With network adapter cards, for example, throughput can be affected by the network operating system, drivers, and other factors. Parallel-port throughput depends in part on CPU speed, modem throughput changes according to the compressibility of the file and line conditions, and hard disk controller throughput hinges on disk design, caching, and interleave. Your own mileage will vary.

| EQUIPMENT TYPE                | SIGNALING SPEED   | THROUGHPUT        |
|-------------------------------|-------------------|-------------------|
| V.22bis modem*                | 2.4 Kbps          | 2.22 to 2.26 Kbps |
| Serial file-transfer software | 115.2 Kbps        | 20 to 80 Kbps     |
| Floppy disk controller        | 250 to 1,000 Kbps | 250 to 1,000 Kbps |
| Hard disk controller          | 8 to 320 Mbps     | 4 to 80 Mbps      |
| Parallel port                 | 400 to 1,200 Kbps | 90 to 1,440 Kbps  |
| Enhanced parallel port (EPP)  | 16 to 64 Mbps     | 3 to 5 Mbps       |
| Ethernet adapter card         | 10 Mbps           | 1 to 3 Mbps       |
| Token-Ring adapter card       | 4 to 16 Mbps      | 1 to 8 Mbps       |
| FDDI adapter card             | 100 Mbps          | 25 to 70 Mbps     |

\* 2,400-bps modem not running MNP 5 compression.

In addition to compatibility with the cabling and the PC, when planning your network, you must consider compatibility of your chosen adapter with the chosen networking software.

Companies take three different approaches to the problem of compatibility between the adapter and the operating system. Both Microsoft and Novell offer driver specifications so vendors do not have to write their drivers to specific networking software. Vendors write to the driver specification and the driver can then run with any networking software written to that specification, such as IP (Internet Protocol),

IPX (Internet Packet Exchange), or NetBIOS (Network Basic Input/Output System).

Microsoft developed its specification

with 3Com as part of the *LAN Manager* operating system. It is called the *Network Driver Interface Specification (NDIS)*. Most LAN adapters now come with NDIS-compliant driver software. Novell's specification, the *Open Data-link Interface (ODI)*, is not yet as widely supported by the market.

Some manufacturers of LAN adapters, such as Intel and Standard Microsystems Corp., try to ensure compatibility by shipping their adapters with a disk full of drivers for different network operating systems. Artisoft and D-Link take the reverse approach. They clone the operation of an adapter with a wide range of support, the Novell NE2000 (marketed by Eagle Technology), in order to take advantage of the large library of software already published for these boards.

When you shop for LAN adapters, make sure that the adapters you buy have NDIS drivers, as an insurance policy against obsolescence. If you plan to use Novell's *NetWare* operating system, check for ODI drivers as well.

#### ETHERNET

Ethernet—often called by its IEEE number 802.3—describes a broad set of standards. Though there are some technical



## CONNECTIVITY

### LAN FUNDAMENTALS 1

differences between the frame formats of the Ethernet and 802.3, the terms are largely interchangeable.

IEEE 802.3 describes a listen-before-transmit media-sharing system called carrier-sense multiple access with collision detection (CSMA/CD). Ethernet cards share the common wire by transmitting only when the channel is clear. If two stations try to transmit simultaneously, a collision occurs. The stations halt transmission and wait a random period of time before retransmitting. This approach makes Ethernet a contention protocol.

Ethernet uses a signaling rate over the wire of 10 Mbps. This sounds impressive, but with contention and other overhead factors, even the busiest Ethernet networks do not push more than about 8 Mbps over the wire. Due to internal inefficiency, a single midrange PC such as a 16-MHz 386SX will enjoy little better than 1 Mbps of effective throughput. Note that four to eight very busy PCs will saturate the capacity of a single wire. Fortunately, the PCs on a typical network access the wire infrequently and briefly.

If cost is an issue, check out Ethernet. A quick survey of the industry showed at

least 30 firms actively marketing Ethernet adapters, and it is easy to recommend a few top adapters that are readily available. The prices listed below are retail quotes from the companies. Some of the higher prices deflate rapidly through direct-order channels, while some of the lower prices are close to the price you will pay. As an example, the popular NE2000 (formerly from Novell and now from Eagle Technology) carries a retail price of \$235, but Computer Discount Warehouse (800-326-4239) recently advertised the NE2000 at \$157.06.

Eagle Technology (408-441-7453) has eight Ethernet adapters in its product line, ranging from the \$190 8-bit ISA NE1000 to the \$995 32-bit EISA NE3200.

SMC, the Systems Products division of Standard Microsystems Corp. (800-762-4968 or 800-833-4762 in Canada), offers nine Ethernet EliteSeries cards, many acquired from Western Digital. These range from the \$199 EtherCard PLUS Elite 8-bit ISA coaxial adapter to the \$349 EtherCard PLUS Elite 10T/A.

3Com Corp. (408-764-5000) markets

nine PC-style Ethernet adapters. The \$295 EtherLink II is the industry standard for 8-bit ISA products. The \$899 EtherLink/MC32 provides 32-bit service in many servers.

Intel (503-629-7354) is an impressive new contender in the LAN adapter market, offering a known company name, a commitment to the market, and a great price. Intel's EtherExpress 16 sells for \$199, and the EtherExpress 32, a 32-bit EISA adapter, is priced at \$795.

#### TOKEN-RING

As opposed to the contentious opportunism of Ethernet, Token-Ring (IEEE 802.5) systems use what is termed a deterministic media-access control system. The "token" in Token-Ring is actually a special frame, passed from node to node, that gives a node permission to enter a frame into the ring. There is no contention for the wire, only an orderly rotation of the permission to transmit. According to the IEEE 802.5 standard, the signaling rate for this technique occurs at 4 or 16 Mbps.

The "ring" part of Token-Ring refers to the way the wiring hub at the center of a Token-Ring LAN puts all of the nodes in

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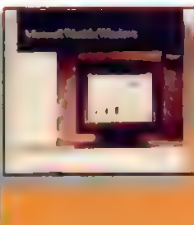
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|----------------------------------|-------|
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**Norton Utilities 6.0** **189**  
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 San Diego, California  
 October 31, 1991

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**XC 1410 C VGA** **236**  
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**Princeton Ultra 1400** **420**  
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**Hayes Optima 24**  
 An affordable, high-quality 2400 bps modem for both business and personal use. This full-featured modem supports V.42bis error-control and data compression to provide 9600 bps throughput, and comes complete with free Smartcom EZ software

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 HiJaak 2.1 is the graphics conversion and screen capture utility that translates more than 43 graphics file formats and captures DOS and Windows screens.

**\$99**

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## CONNECTIVITY

### LAN FUNDAMENTALS 1

series electrically. The electrical impulses literally go from node to node instead of being broadcast into the cabling, as they are in Ethernet.

The main reason to consider a Token-Ring installation is IBM's backing. Today, Token-Ring is the best way to link PCs to installations of IBM minicomputers. PCs and mainframe computers can function as peers on the same Token-Ring network, and IBM functional software

such as the Advanced Program-to-Program Communications (APPC) service can link applications on both kinds of systems. (APPC is a protocol used for peer-to-peer communications in IBM's Systems Network Architecture, or SNA.)

Under some conditions, Token-Ring users may actually see a performance improvement over what they would get

with Ethernet. But in most installations that difference is imperceptible. You can reduce the traffic load before it reaches the point where the differences between CSMA/CD and token-passing would come into play.

The big problem with Token-Ring is cost. While Ethernet adapters can run as low as \$200 each, Token-Ring adapters tend to cost twice that amount. Currently, at least 20 companies market Token-Ring adapters. IBM (800-426-2468) sells the largest number, but products from Intel, Madge Networks (408-441-1300), Olimcom (214-596-8016), and Proteon (508-898-2800) are widely accepted in the industry. IBM's ISA 4Mb adapters sell for \$395. The IBM 16/4 adapter, a 16-bit ISA adapter for 4- or 16-Mb Token-Ring, costs \$895. Compaq Computer Corp. (800-231-0900) sells high-performance 32-bit DualSpeed EISA Token-Ring adapters for \$1,299 each. Intel's ISA 16/4 LAN adapter carries a retail price of \$695. Madge makes a \$945 16-bit data, 32-bit addressable Smart 16/4 AT Ringnode with UTP filter and RJ-45 jack with media filter. Olimcom sells an ISA 4Mb/16Mb adapter for \$895. Proteon markets an \$895 16-bit adapter with bus-mastering capability.

#### FDDI: FAST AND PRICEY

FDDI, also known as ANSI X3T9.5, is a standard that specifies transmission at 100 Mbps. The FDDI standard defines two physical rings that simultaneously send data in different directions. By sending data in opposite directions, the configuration is designed for reliability.

Codenoll Technology Corp. (914-965-6300) markets FDDI LAN adapters for ISA PCs priced at \$4,995 and \$7,395, depending on whether you want to take advantage of the full dual-ring capability of FDDI. Network Peripherals (408-321-7300) offers an ISA-bus FDDI adapter for \$1,995. Optical Data Systems (ODS) (214-234-6400) is an excellent source of FDDI information and equipment. ODS carries useful adapters, transceivers, and other often-overlooked pieces and parts that you need to make an FDDI system work.

The robust FDDI architecture is so appealing that companies such as Crescendo Communications (408-732-5935), Digital Equipment Corp. (DEC) (508-493-5111), and Microdyne (703-739-0500) have announced products that use the 100-Mbps FDDI architecture over different types of copper wiring—



Smart-UPS 600

On Line Test Alarm: Lethal

On Back-Up Overload Low Battery Replace Battery

Off Power On

## The Smart-UPS

by American Power Conversion

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- Battery replacement LED, load and voltmeters
- 400 to 2000VA in both 117V and 220/240V models

1986, 1990 PC Magazine Editor's Choice

1989, 1990 Reseller Management "Best to Sell UPS"

1990, 1991 LAN Times, Readers' Choice

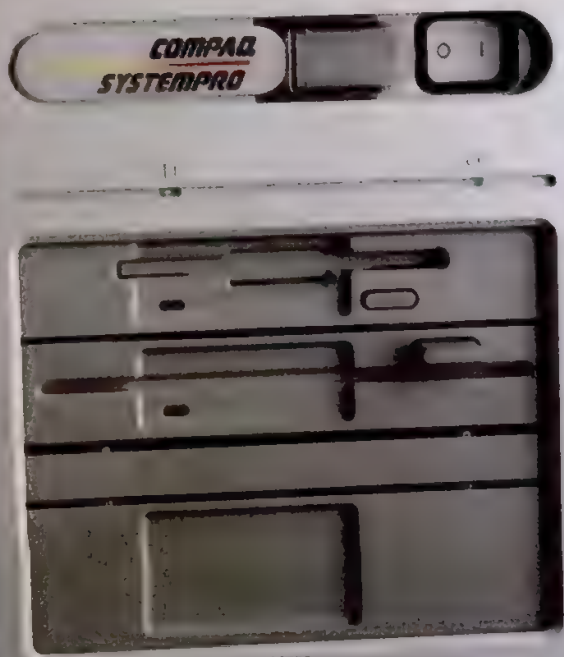
1989 PC Week, "All Around Reliable Choice"

1990 InfoWorld, "Value Leader"

1990 Systems Integration, Product of the Year

1991 Byte Magazine, Best UPS for LANs

NOVEMBER 1990  
TESTED AND  
APPROVED  
Hardware Compatible



COMPAQ SYSTEMPRO

CIRCLE 281 ON READER SERVICE CARD



# Last time, it was the experts' choice. This time, it's the easy choice.

## The new IRMA WorkStation for Windows 1.1

From the very beginning this 3270 emulation software was the



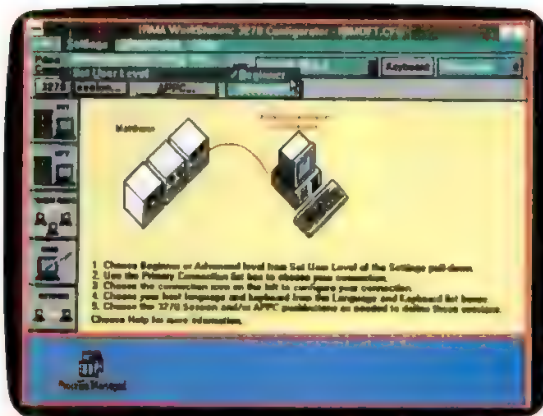
February 26, 1991  
IRMA WorkStation  
for Windows,  
Ver. 1.1

No. 1 choice of experts like the editors of *PC Magazine*. It brought a host of sophisticated features into the wonderful world of Windows™ connectivity. But it was only the start.

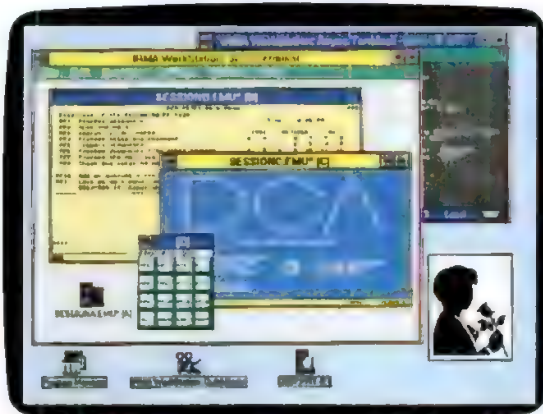
Now, we've made IRMA™ WorkStation for Windows so incredibly simple to install and operate, that it's the easy choice for anyone!

The new 1.1 version virtually installs itself. Instead of asking endless questions during "SET-UP", it senses your communications adapter and then pre-configures the software accordingly. Say you have an IRMA 3® Convertible coax card. With the "Intelligent User Assist" program it will automatically pre-configure the CUT and DFT connections. If you have an IRMAtrac™ token-ring adapter, it will pre-configure a token-ring connection.

Once installed, our new software is easier to operate, too. Using the familiar Windows Multiple Document Interface (MDI), you get the easy efficiency



*Installation couldn't be easier! The new Intelligent User Assist automatically senses the communications adapter in your PC. A Configurator Screen shows your PC and its connection to the mainframe.*



*Multiple Document Interface (MDI) lets you manage multiple communications sessions with a single menu bar in the main 3270 terminal emulation window.*

**IRMA WorkStation for Windows**  
Another Communications Solution From

# DCA.

of managing multiple sessions with a single menu bar.

Integrating mainframe data into your other Windows applications is no problem either. You'll find a breadth of application integration tools like macros, QuickScript™ with DDE, HLLAPI and APPC.

Just as important, with this IRMA software package, you can get into "Windows" connectivity no matter how you're connected. There's CUT, DFT, SDLC, token-ring and asynchronous connections. And what's more, IRMA WorkStation for Windows can now even act as client software for DCA's IRMALAN™/EP 3270 NetBIOS gateway. No one offers as many connectivity options!

## It's even easy to try!

Trying out the new IRMA WorkStation for Windows 1.1 is as easy as asking for a copy of our **FREE DEMO DISK**. Better yet, you can trade up to IRMA WorkStation for Windows from any other 3270 connectivity software (that's right, ours or anyone else's) for only \$95. All you do is call.

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# Network Cabling Guide:

## Building a Reliable Infrastructure

**A** reliable cabling plant is crucial to a network's viability, which is why savvy users often spend long hours researching the different types of cabling available. You have a simpler option. The following three pages hold all the basics you will need to know before choosing the right type of cabling for your network, including information on which wires can be used with the different types of networks. We have also added some pricing quotes, courtesy of the Black Box Catalog; most prices are based on a thousand-foot spool of plenum cable. (Black Box is a reliable cabling supplier, though not the least expensive.) The pricing information should help guide you in planning the comparative costs of your options.



## CABLES FOR EACH NETWORK

■—Yes    □—No

|                                    | ARCnet | Ethernet | Token-Ring | FDDI |
|------------------------------------|--------|----------|------------|------|
| Voice-grade UTP                    | ■      | □        | □          | □    |
| Data-grade UTP (IBM Types 3 and 4) | ■      | ■        | ■          | □    |
| STP (IBM Type 1)                   | □      | □        | ■          | □    |
| RG-62 (coaxial cable)              | ■      | □        | □          | □    |
| Thicknet coaxial cable             | □      | ■        | □          | □    |
| Thinnet coaxial cable              | □      | ■        | □          | □    |
| Fiber-optic cable                  | ■      | ■        | ■          | ■    |

|          | 10Base5                         | 10Base2                        |
|----------|---------------------------------|--------------------------------|
| used for | Ethernet trunk cable (thicknet) | Ethernet trunk cable (thinnet) |
| stranded | 2.17-mm. solid                  | 0.89-mm. solid                 |
|          | 10                              | 10                             |
|          | 5.18                            | 14.00                          |
|          | 50                              | 50                             |

### FIBER-OPTIC (IBM/FDDI specification)

Specification (for 62.5-/125-micron cable) 850 nm.    1,300 nm.

Attenuation (dB km.)    3.75    1.5

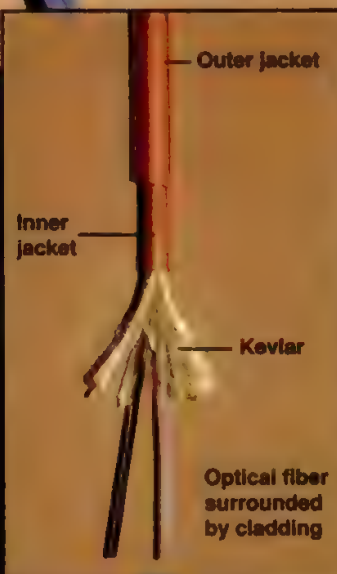
AUI connector



BNC connector



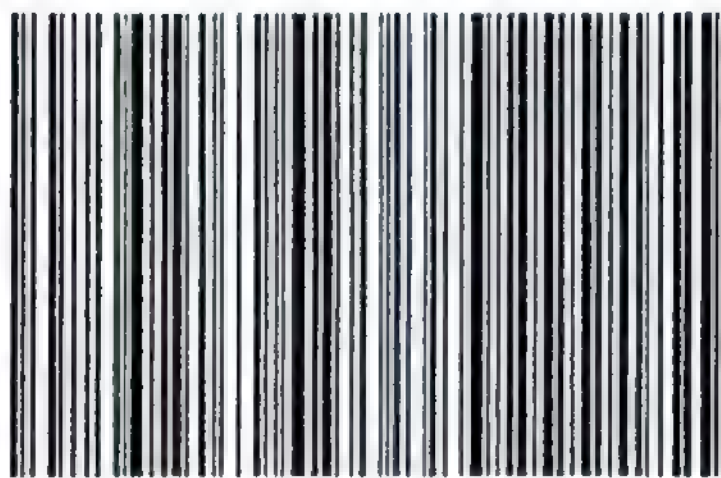
ST connector





1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

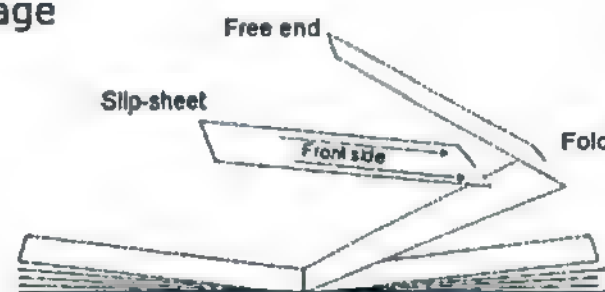


GbsSlipSheet-001

Folded edge of the page

Foldout slip-sheet

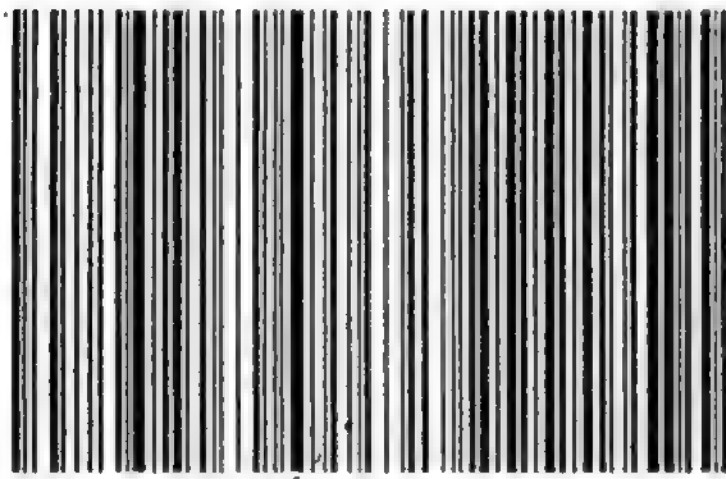
1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





1. Follow instructions on the other side

Inverted Back



Gbs5lipBack-001B

Back

1. Follow instructions on the other side

The three important types of LAN cabling all share certain characteristics. Specifications of those characteristics lead to the staggering variety of cables available.

All cables have one or more conductors. For the UTP cable shown at the left, the conductors are individual wires twisted into pairs and encased by a sheath. In the case of STP, metallic shielding and braid surround

the pairs under the sheath.

The middle cutaway shows the sheathing, copper braid, dielectric, and single central wire of a coaxial cable. Twinaxial and triaxial cable are also available; these have two and three wires, respectively.

The fiber-optic cable at the right shows the twin light conductors. The yellow material provides insulation and padding.

**TWISTED-PAIR (IBM specification)**

| Specification                   | Type 1   | Type 2   | Type 3      | Type 4      | Type 5               |
|---------------------------------|----------|----------|-------------|-------------|----------------------|
| Shielded or unshielded          | Shielded | Shielded | Unshielded  | Shielded    | Shielded             |
| Gauge                           | 22 solid | 22 solid | 22-24 solid | 26 stranded | 26 solid or stranded |
| Number of pairs                 | 2        | 2*       | 4           | 2           | 2                    |
| Data rate (Mbps)                | 16       | 16       | 1           | 16          | 16                   |
| Attenuation (dB/km.)            | 45       | 45       | 8           | 66          | 55                   |
| Near-end crosstalk (dB)         | -40      | -40      | N/A         | -34         | -34                  |
| Characteristic impedance (ohms) | 150      | 150      | 84-113      | 150         | 150                  |

**COAXIAL CABLE**

| Specification                   | RG-58/U           |
|---------------------------------|-------------------|
| Type                            | Commonly thinnest |
| Gauge                           | 20 solid or       |
| Data rate (Mbps/sec)            | 10                |
| Attenuation (dB/1,000 ft.)      | 14.00             |
| Characteristic impedance (ohms) | 50-53             |

**Token-ring data connector**

Jacket  
Pairs of conductors

**RJ-45**

**RJ-12**

**RJ-11**

Jacket  
Copper braid  
Dielectric  
Central conductor

All connectors shown at scale



## CABLING TYPES

**Cabling comes in many different sizes, but there are only three basic types: coaxial, fiber-optic, and twisted-pair. Twisted-pair may be either shielded or unshielded.**

**coaxial cable** A single wire surrounded by insulation and a woven copper braid or foil that acts as shielding against electromagnetic noise. Ethernet networks use two general types of coaxial trunk cable, known as thinnet and thicknet. Thinnet is sometimes confused with RG-58, a wire with slightly different electrical properties. Thinnet is priced at 55 cents per foot and uses BNC connectors. Thicknet is occasionally used for backbones (highly trafficked wire connecting two or more servers). Thicknet costs \$1.90 per foot, and its size makes it difficult to install.

**fiber-optic cable** A pair of thin strands of glass (or, in the future, plastic) surrounded by an insulating fiber. Compared with copper cabling, fiber-optic cabling offers higher security, capacity, and immunity to electrical interference. Fiber is an excellent choice for building backbones. The cable sells for around \$1.50 per foot; connectors cost \$6 to \$7 each.

**unshielded twisted-pair (UTP)** Cabling containing two or more pairs of twisted copper wires. The twisting reduces electrical noise. UTP comes as voice-grade or data-grade.

UTP's advantages include low cost of materials and ease of installation. Typical drawbacks are more limited signaling speeds (especially in voice-grade) and shorter possible distances.

The cable shown is plenum 4-pair IBM Type 3 cable. Type 3 specifies two pairs of

24-gauge solid copper wire. Voice-grade UTP cable is typically priced at about 10 cents per foot; data-grade UTP at around 12 cents per foot. UTP is used in telephone networks, but you should still test your cable installation before running network data over it. A device such as the \$2,495 Pair Scanner, from Microtest Corp. (602-971-6464), will tell you which wire pairs you can trust.

**shielded twisted-pair (STP)** Cabling with a foil shield and copper braid surrounding the wire pairs. STP cabling offers high-speed transmission over useful distances, but its size quickly fills wiring conduits. The cable shown is IBM Type 1.

IBM specifies Types 1, 2, 6, and 9 STP cables in its general wiring plan. IBM Type 1 cable uses solid wires in the pairs. Type 2 cable combines shielded and unshielded wiring in the same sheath. Type 6 cable uses stranded wire in the pairs for greater flexibility and typically connects to a LAN adapter. Type 9 plenum cable is similar to Type 6 cable with a fire-resistant outer jacket.

Type 1 STP cable sells for 90 cents per foot, Type 2 cable for \$1.20 per foot, Type 6 cable for 35 cents per foot (PVC only), and Type 9 cable for 70 cents per foot. The connector used on the end of each cable furthest away from the PC costs \$11.

## CONNECTORS

**BNC** A connector for coaxial cable used with thin Ethernet (thinnet) and ARCnet (RG-62) cabling. BNC connectors cost about \$2.50 each.

**data connector (Type 1)** A connector designed by IBM for use in Token-Ring wiring centers. Though somewhat more expensive than a similar D-shell 9-pin

plug, this connector can be mated to an identical connector (to patch or extend lines) without special installation tools. The connectors are priced around \$11 each.

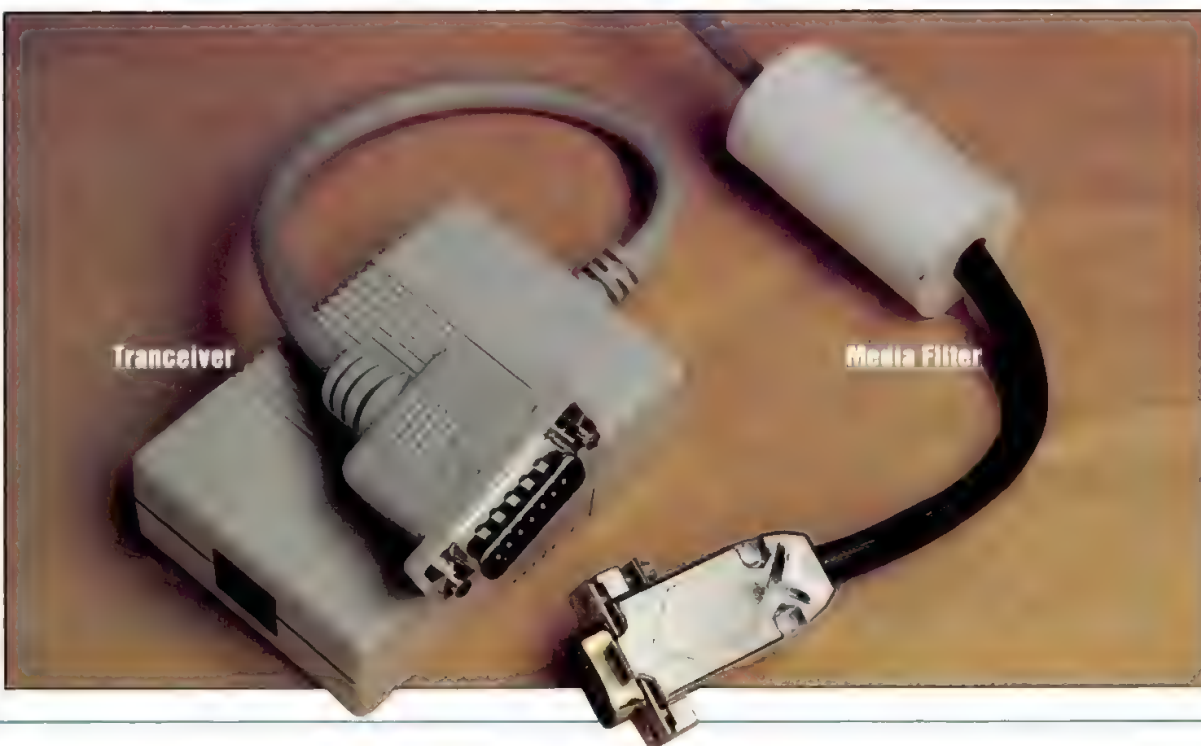
**RJ-11** A plastic plug typically used for telephone cables. RJ-11 connectors are available for 2- and 3-pair cables; each connector costs around 55 cents.

**RJ-45** A plastic connector typically used for UTP wiring and for leased telephone line connections. An RJ-45 connector can attach up to four pairs of wires (eight contacts). The RJ-45 connector is slightly larger than the RJ-11; RJ-11 plugs can fit into RJ-45 jacks, but not securely. Each connector costs less than 90 cents. Be warned: Some connectors designed for stranded wire may initially work if crimped onto the more common solid-wire cable, but they usually fail over time.

**straight tip (ST) connector** A connector for fiber-optic cable. ST connectors maintain the perfect alignment of the ends of the connected fibers that is important for efficient light transmission. ST connectors cost \$6 to \$12 each.

**media filter** A device that switches between UTP and STP cables in a Token-Ring network. A Type 3 Token-Ring media filter is shown here. Unlike a transceiver, which is an active Ethernet device drawing its power from the computer, a media filter is a passive Token-Ring unit consisting mainly of coils and capacitors.

**transceiver** An external device that translates between the LAN adapter and some different cabling and connector scheme. The external Ethernet transceiver shown here translates between AUI and thicknet.



"Users have got to love the plug and play of the new DEC products; the fact that users can set up the systems in about 30 seconds is great and the products should sell well on that basis alone."

—Doug Gold, director of communications research at International Data Corporation, as quoted in *LAN TIMES*, April 15, 1991



uct. DEC has used its miniaturization and packaging engineering talents to, in effect, create the industry benchmark example for the right way to design a complex communication product acceptable for use in an exposed commercial workplace as well as a telephone closet . . ."

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—*Business Week/Industrial Designers Society of America Awards*, June 17, 1991

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—Frank Dzubeck, president, Communications Network Architects, Inc., October, 1991

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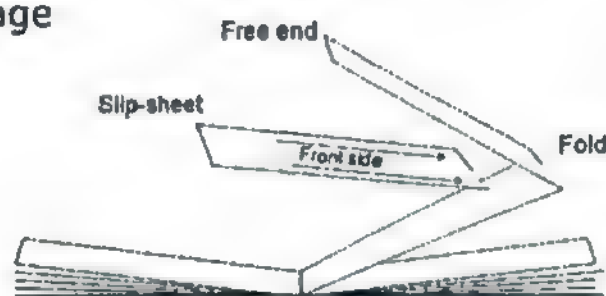
1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
  3. Slice the folded edge
  4. Close the page and slip-sheet

Inverted Foldout slip-sheet



Foldout slip-sheet

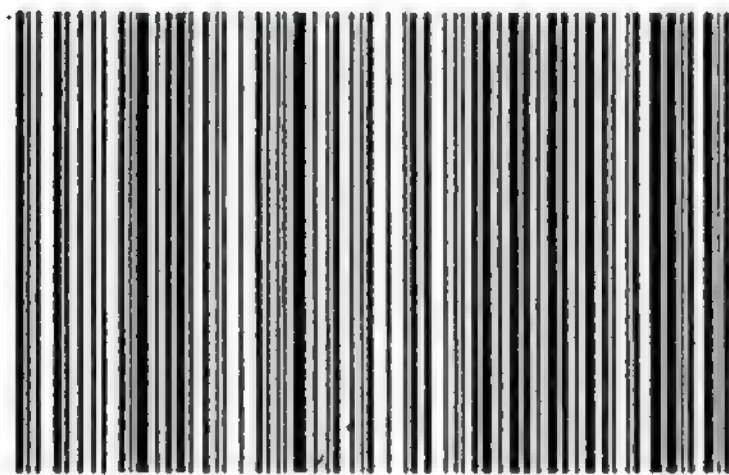
1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
  3. Slice the folded edge
  4. Close the page and slip-sheet





1. Follow instructions on the other side

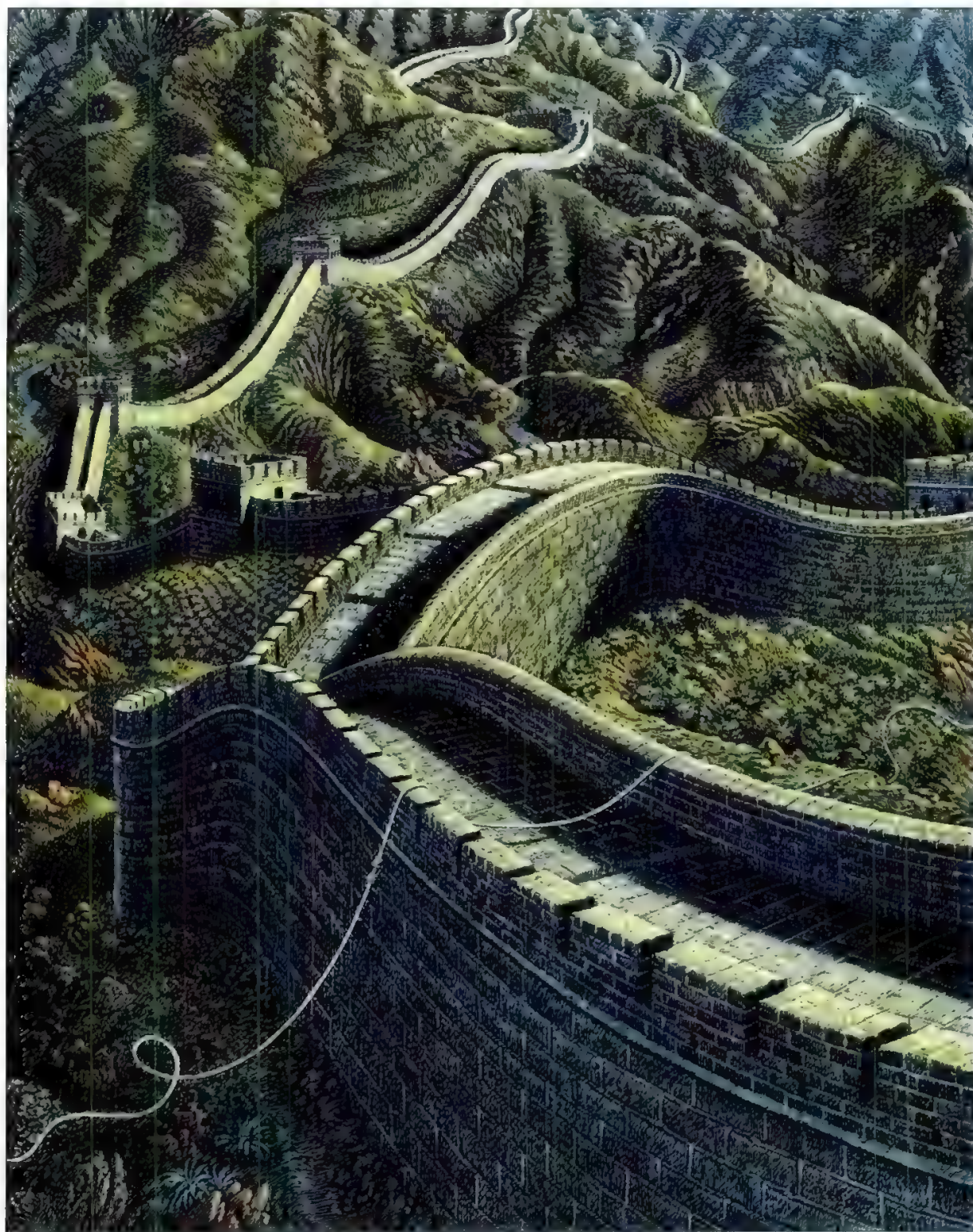
Inverted Back



GbsSlpBack-001B

Back

1. Follow instructions on the other side



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### DIGITAL. THE OPEN ADVANTAGE.



unofficially known as *CDDI*. Microdyne's EXOS 505S is an STP CDDI adapter for PCs and carries a \$1,495 price tag. Crescendo's FDDI/CDDI SBUS is a \$1,495 STP and UTP CDDI adapter for Sun workstations. DEC sells the DECconcentrator 500 for \$6,000. But FDDI over copper is not yet standardized, and products may not interoperate.

### HUBS AND CONCENTRATORS

The industry has toyed with many different ways of laying cabling. Originally, Ethernet was laid in a bus topology: A single cable ran the length of the network with individual cables connecting into the bus. Token-Ring was laid in a ring topology, with each station connected in a circle. More recently, the industry has settled on the star wiring scheme. With a star wiring scheme, every cable runs back to a central hub or concentrator that connects these cables together. The term *wiring center* is also used as a generic reference for both hubs and concentrators.

You can install any type of cabling for any type of LAN in the star topology. But you must configure the equipment at the center of the star, the wiring center or hub, for a specific MAC scheme such as Ethernet or Token-Ring and for a specific type of cabling. Because it is literally at the center of the network, the wiring center or hub is an excellent place to install network monitoring and management software. A full review of 10BaseT wiring centers and hubs was reported in "Wired for Intelligent Management: 10BaseT Hubs and Concentrators" in our November 12, 1991, issue. (10BaseT is the specification for running Ethernet over UTP.)

Wiring hubs and concentrators are both typically installed in the same place: the telephone wiring closet. The term *closet* survives, even though these may be 15-by-15-foot rooms with their own air-conditioning and power systems. Whether your wires come together in a special room, a real closet, or under someone's desk, *PC Magazine* urges you to remember to provide backup power for the wiring center. It does little good to provide backup power for the server and client PCs if the wiring center fails.

The differences between a hub and a concentrator are not engraved in stone, but they are real. A hub is typically a simple device contained in one cabinet; it has little flexibility but a reasonable price

(if you consider \$400 to \$800 for eight connections reasonable). A hub usually only connects to nodes with one specific type of cabling, but it is not unusual to have a separate coaxial cable or fiber connectors for hub-to-hub links.

A concentrator has many pieces, parts, and options, including a cabinet, power supply, and various connection modules. Each module, about the size of a hardback novel, slides into the cabinet and connects to a data bus. You can typically insert modules with different cable connectors into the cabinet and add devices such as bridges and routers. You might select options for a concentrator such as dual power supplies for reliability or add management modules and even LAN-to-LAN options such as an interface to a high-speed long-distance telephone circuit. A fully loaded concentrator able to handle 48 ports with sophisticated management and some fiber connections could top \$50,000.

In late 1991, some companies, including Novell and Artisoft, made provisions for the installation of wiring hubs in PCs acting as file servers. That's an interesting approach for a small office LAN, but it's only practical in large LANs with a combined server room and wiring closet.

One thing you do not have to worry about is compatibility between the brand of hub or concentrator and the brand of LAN adapter card. You can mix cards and wiring centers from different vendors, as long as they use the same MAC scheme and cabling.

As your network grows, the management capabilities of your cabling system become more important. Hubs and concentrators often have their own microprocessors in the 80186 class and programming contained in ROM. These processors can count the packets of data as they fly by, recognize errors in the stream of data, and generate reports. They hold data in a database, often called a *management information base (MIB)*, until it is polled by a computer running management software. These processors can protect the network by automatically disconnecting

nodes that are generating bad data. In some cases, they can enhance security by restricting the day of the week and even the time of day that specific nodes may enter the network. They can also send special messages, called *alerts*, to computers running network management software.

A signaling and reporting scheme called the *Simple Network Management Protocol (SNMP)* provides one architecture for network reporting and management. SNMP includes "agent" software that gather data in wiring centers and in other network devices and computers that

act as management stations. The management computers can be PCs, typically running Windows, or they can be other platforms such as Sun workstations running Unix. Formally, SNMP was exclusive to the TCP/IP environment. But

Synoptics (408-988-2400) has demonstrated SNMP over the popular *NetWare* IPX protocols and there is now a specification for running SNMP over Apple's *AppleTalk* protocol.

While SNMP is the most widely supported management scheme, IBM's *NetVIEW* and the *Common Management Information Protocol (CMIP)* developed by the *International Standards Organization (ISO)* are evolving as competitors.

Various companies make hubs and concentrators for Ethernet, Token-Ring, and FDDI that offer different cabling options. Some vendors offer hubs that support all three protocols simultaneously.

Artisoft markets a low-cost Ethernet hub called the *Peer-Hub* that mounts inside a PC and includes its own management software. A single card able to connect to five nodes carries a \$399 price tag, and you can add cards and connections until you run out of PC expansion slots. David Systems (408-720-8000) offers a wide selection of simple wiring hubs and sophisticated concentrators; its products range from the \$995 *VolksNet* hub that makes 12 10BaseT UTP Ethernet connections to the *ExpressNET* Intelligent Concentrator that can cost over \$10,000 for a sophisticated concentrator able to manage 48 connections.

The *DEChub* 90 series of wiring con-

 **Some vendors market hubs that support Ethernet, Token-Ring, and FDDI.**



centrator products, from Digital Equipment Corp., is a flexible concentrator system that starts out with an \$890 backplane and holds a series of plastic-cased modules (examined in "The Best of 1991," January 14, 1992). The eight-port DECRepeater 90T for 10BaseT wiring carries a \$1,540 price tag. Other companies, including AT&T (800-247-1212) and Hewlett-Packard, market Ethernet wiring concentrators.

In the Token-Ring arena, the names of the products change a little. IBM called its Token-Ring wiring center a Multistation Access Unit or MAU, so this term is often used when referring to Token-Ring wiring center products. As with Ethernet, you can buy simple Token-Ring wiring hubs or much more complex management systems. For example, you can buy a \$450 four-port Local Hub from Madge Networks or a \$630 eight-port 8228 from IBM. Your budget is the only limit. Cabletron Systems (603-332-9400), IBM, Madge, Optical Data Systems, Synoptics, Thomas-Conrad (512-836-1935), and other vendors make a variety of concentrators for Token-Ring, with options that can push the costs over \$50,000 for

a 48-node concentrator.

At this time, there is little difference between Token-Ring wiring centers for 4-Mbps and 16-Mbps Token-Ring. But IBM and Synoptics have proposed a new standard for 16Mb Token-Ring UTP wiring centers that would electrically break the wiring into smaller segments by using a retiming circuit on every port. The plan is to make the faster signaling of 16Mb Token-Ring more viable over UTP wiring, but at an added cost.

You can buy a simple unpowered passive hub that will carry signals to four nodes over about 100 feet of coaxial to each node for under \$100. Active hubs, available for a variety of cabling, run from \$500 devices for eight ports of coaxial cable with a 2,000-foot range to a little over \$2,000 for eight fiber connections with a range of more than a mile.

FDDI hubs are often more expensive. DEC, AT&T, and Timeplex (201-368-1113) make dedicated FDDI hubs. Cabletron Systems, Synoptics (408-988-2400), and Ungermann-Bass (408-496-0111) make FDDI hubs that support FDDI,

Ethernet, and Token-Ring. Synoptics' LattisNet Model 3000 Premises Concentrator sells for \$4,495 (chassis only) or \$6,495 (with redundant power supply). Ungermann-Bass makes the Access/One, which sells for \$2,095 (hub only) or \$3,350 (with the supervisor card). Cabletron plans to expand its FDDI line later this year.

*PC Magazine* recommends a star wiring system for all but the smallest network installations. When you grow to a couple of dozen nodes, or anytime the network is running on mission-critical applications such as order taking, we recommend buying wiring centers with management capabilities.

## NETWORK OPERATING SYSTEMS

We have spent a lot of time discussing cabling because it is so essential. You must decide on a cabling architecture up front, and initial decisions are expensive to change. But after the original installation, most of the time spent working on the network will involve the networking software.

The function of the networking software is to set up some computers as hosts or servers, and some computers as clients to those hosts. The servers offer printer sharing, file sharing, and communications link sharing to their clients. All of these capabilities may run on a single server or be dedicated to separate servers.

For the most part, the networking software can run over any standard network such as Ethernet, Token-Ring, or FDDI. But, as noted earlier, either the company selling the LAN adapters or the company selling the network operating system must supply the driver software that links the networking software and the adapters together.

## DOS OR NON-DOS

Network operating systems break down into two categories: those that use DOS as the file system on the server and those that use another file system such as Unix. Often the non-DOS products centralize the file-server functions on one computer that runs the non-DOS specialized file-handling system. The DOS-based products allow any PC on the network to make files, subdirectories, and entire disk drives available for sharing across the network. Look for a complete review of DOS-based networking packages in an upcoming issue of *PC Magazine*.

Each PC acting as a client loads a couple of pieces of software: a redirector

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19.2 Kbps using V.42bis and compression. Its small  
modem can reach a lot of new and potential users.



and a driver. The redirector fools DOS into thinking that the PC has more hard disks attached than it really does. The redirector then takes requests sent to those disks from applications or the command line and routes them out to the network. The redirector accesses the network through the driver, which talks to the redirector on the top and to a specific make and model of LAN adapter on the bottom. The client software typically takes less than 45K of RAM and, if you have the room, you can load it into high memory with any memory manager.

The network communications software in the stack encapsulates the messages from the redirector into a packet of data containing specific identification and destination information. Then the network adapter wraps that packet inside a frame for transmission across the wire. At the receiving side, the LAN adapter frees the communications packet from the transmission frame and passes it up through the stack to the networking software.

Typical formats for the network communications packets include the aforementioned IPX (from Novell), NetBIOS (used and expanded by Microsoft and IBM), and IP (developed by the U.S. Federal Government and now widely used in all sectors). Today, it is possible to load more than one communications protocol stack into a client PC and use servers running networking software packages from different vendors simultaneously. For a more complete explanation of the communications layers and how they interact, see "Unix Services for DOS-Based PCs" in our May 28, 1991, issue.

The computer acting as a server (of any type) has a driver stack to communicate with the LAN adapter, and it runs other modules that work in the background to receive and act on requests from the client PCs. The actions of the server software include checking the rights of the user to make the request and passing the request on to the local disk operating system in an understandable format. DOS-based server software occupies between 50 and 150K of RAM and, when it is busy, takes some slices of time from the other foreground tasks the processor is performing. In a DOS-based system, any PC on the LAN can load the client software, the server software, or both.

In non-DOS systems, the server software alone can occupy 4MB or more of hard disk space and require 4MB to 16MB of RAM to run. But most non-DOS server

systems still provide some way to use the server to run local applications if desired. Various software modules in the server package allow for the sharing of hard disks, printers, and communications ports. In a small network you might decide to put all three types of services in one PC, but in a larger network you will probably split the different types of services among several PCs, each acting as a different type of server.

As we noted earlier, the DOS-based network operating systems are less expensive for LANs of 2 to 12 PCs, usually about \$100 per node for the software alone. The non-DOS packages carry a price based on the number of users on a server, so the per-user cost on a small LAN can range from several hundred to a thousand dollars; on a larger LAN, the price can drop to \$100 or less per user. But price comparisons are tricky: When companies such as Artisoft market their DOS-based packages in starter kits with adapter cards, they lower the prices so much that they do not seem to charge for the software at all.

Before the introduction of MS-DOS 5.0 and the availability of reasonably priced PCs with 80386 and 80486 processors, there was a significant difference between the capabilities of the two categories of network operating systems. There were good reasons to employ the ability of non-DOS file systems such as Unix to handle very large disk drives and to use the memory above 640K. But DOS 5.0 can handle hard disks of 2 gigabytes and it has a good memory manager. The DOS 5.0 operating system still is not as powerful as Unix or OS/2, because it cannot handle multitasking. But the DOS-based operating systems add a time-shared multiprocessing capability to DOS, and the powerful CPUs in modern PCs do not miss a step even as they service dozens of clients.

This is not to suggest that DOS-based network operating systems are equal to the non-DOS products in total power or the features they offer. The non-DOS products can handle several hundred client PCs on a single server and provide tools for connecting networks together. They have facilities called *naming services* that make it easy to find and use resources over

# Actual Size.

1000  
High Speed  
Blower

**QBlazer**  
1000 High Speed Blower

TELEFLEX

TELEFLEX

**QBlazer**  
1000 High Speed Blower



## CONNECTIVITY LAN FUNDAMENTALS 1

LANs with hundreds of servers; they can easily link Macintosh computers into the network, and they provide a solid base for sophisticated applications specifically designed for the network.

The list of DOS-based network software packages includes more than a dozen companies. Some major players are Artisoft, Novell (801-429-7000), and Performance Technology (512-349-2000). Other companies with excellent products include Invisible Software (415-570-5967), D-Link (714-455-1688), Compex (714-630-7302), and Tiara Computer Systems (415-965-1700).

Artisoft's *LANtastic* is small, fast, easy to use, and moderately priced. The recipient of numerous Editors' Choice awards and an Award for Technical Excellence, *LANtastic* is popular and well supported. Artisoft also markets an excellent line of LAN adapters and innovative products;

its new \$595 Central Station Connectivity Processor acts as a complete print server and communications server on *LANtastic* and *NetWare* LANs. *LANtastic* is priced at \$699 for the Ethernet Starter Kit, including two AE-2 network adapter cards,

25 feet of coaxial cable, and software able to support up to 300 nodes. If you want to add more nodes, you simply buy more hardware.

Performance Technology's *POWERLan*, also the recipient of an Editors' Choice award, competes

with *LANtastic*, but it has some different capabilities that set it apart. *POWERLan* can integrate computers running DOS, OS/2, and Unix into a single network and has more internetworking flexibility than *LANtastic*. There are several versions of *POWERLan*, with prices for dedicated server packages ranging from \$795 for a

five-user version to \$3,195 for an unlimited package.

*NetWare Lite* is quite different from the other versions of *NetWare*. It provides good service, but Novell limits the \$99-per-node product to 25 users. The software is copy protected and there are no packaging options, so you pay \$99 for the software for every node.

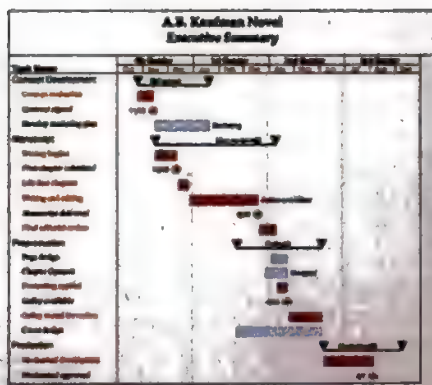
The non-DOS products include Novell's *NetWare* in Versions 2.2 and 3.11, Banyan Systems' *VINES*, and Microsoft's *LAN Manager*.

*NetWare* is currently the market leader in networking software; its non-DOS-based versions are popular and widely supported. The biggest difference between the two non-DOS Novell products stems from the ability of *NetWare* 3.11 to run programs called *NetWare Loadable Modules* (NLMs) in the server. These programs, often provided by third-party companies, include a wide variety of management and administrative applications, communications capabilities, and database server functions that split the processing load between the client PCs and the server.

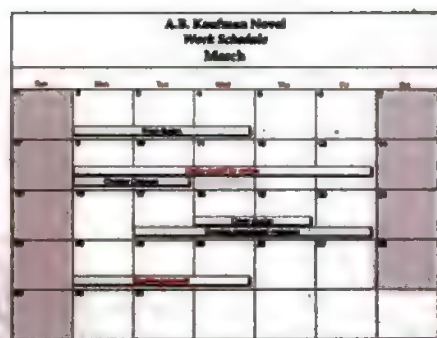
Novell prices a 10-user version of *Net-*

**N**etWare Lite  
is quite  
different from the  
other versions  
of NetWare.

## The CEO wants to know when it will be finished.



## The staff wants to know when they can start.



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It not only makes it easy to present

things the way *they* want, but also lets you plan things the way *you* want.

Now you can enter and view data in a variety of ways—Gantt's, tables, graphs, forms and more. Microsoft Project also has a customizable 'Toolbar,' giving you access

## CONNECTIVITY LAN FUNDAMENTALS 1

Ware 2.2 at \$1,995 and a 100-user version at \$5,495. *NetWare* 3.11 costs \$3,495 for a 20-user version and \$6,995 for a 100-user version.

*VINES* (Virtual Networking System), from Banyan Systems (508-898-1000), is a powerful networking package that is well suited for large networks. *VINES* is best known for its StreetTalk global naming service. StreetTalk names the resources of many servers in many locations so they are easy to find. A 10-user version of *VINES* sells for \$2,495 and a version with no licensing restriction on the number of users costs \$7,495. *VINES* is popular with organizations that have networks with hundreds of nodes and interLAN connections.

*LAN Manager*, from Microsoft Corp. (206-882-8080), was originally designed to run over the OS/2 operating system. (*LAN Manager* is sold in slightly different versions by DEC as *PathWorks* and by IBM as *OS/2 LAN Server*.) Versions have been ported to Unix and will run over Microsoft's announced New Technology (NT) operating system.

*LAN Manager* 2.1, released at the end of 1991, is a capable and flexible network-

ing package that can integrate clients running DOS, Windows, OS/2, Unix, and the Macintosh operating systems. You can dedicate a PC running OS/2 to the role of a file and print server or use it to run local applications. *LAN Manager* 2.1 sells for \$1,995 for a 10-user version; an unlimited user version costs \$5,495.

### SERVER PCs

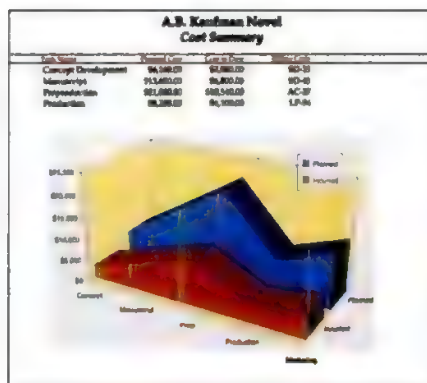
The question of what kind of a computer to select as a server often confuses people. Print servers and communications servers do not need a lot of internal horsepower. For simple installation, you can purchase a closed box suitable for acting as a print server or a communications server from vendors such as Castelle (408-496-0474) or Microtest (602-971-6464). (For information on print servers, see "Shared Lasers: The New Breed" in our November 26, 1991, printer issue.) Designating a print server offers the opportunity to recycle the 286-based machines that nobody wants. For more information on communications servers and LAN-to-LAN communications options, see our

September 10, 1991, issue on connectivity.

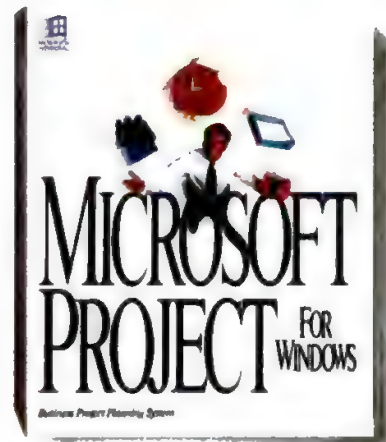
There are some special considerations for the PC acting as a file server, however, whether or not it also runs DOS applications. In our March 17, 1992, issue, we reviewed 22 computers that various manufacturers configured for us as *NetWare* file servers (reported in "486/33 File Servers"). Later this year we plan to review the heavy-duty, specially equipped products dubbed superservers. Our bottom-line advice on file servers is simple: Buy the fastest and biggest SCSI hard disk system you can afford, and have it installed with a motherboard with a 386/33 or 486/33 processor, four to six usable slots (after the video, memory, and hard disk controller are in), at least 4MB of RAM, and a power supply with at least a 300-watt rating. If you plan to run a non-DOS operating system, load in 16MB of memory. If the server will have more than a few dozen active clients, specify EISA or MCA for the expansion slots.

You should also take a few common-sense precautions with your server. Give it an uninterruptible power supply (UPS) for its power, place it in a smoke- and

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#### LINKING LANs

With networks increasing in importance, companies need to connect their resources into a single homogeneous network. For permanent connections, you can link local and remote networks through bridges and routers. Communication servers can provide on-the-fly connections, such as accessing network information from your home or on the road.

Bridges typically connect two or more LANs using the same MAC layer, such as Ethernet to Ethernet. Because they simply insert the traffic from one LAN into the other LAN and do not use sophisticated techniques to send specific messages to specific destinations, bridges are easy to install. So-called *transparent bridges* can either pass everything they hear from one cable to the other or, in more sophisticated products, they can learn which side of the interLAN connection a specific station resides on and only pass the necessary messages.

A number of vendors sell transparent

bridges. Vitalink (510-794-1100), long a leader in remote transparent bridges, offers its TransLAN 320 for \$7,750. Microcom (617-551-1000) provides a bridge running compression, dubbed the MBR 6500, for \$5,500 for an Ethernet version, \$7,000 for Token-Ring.

With source-routing bridges, the sending station explicitly addresses the frame to the bridge. The frame contains forwarding instructions, which the bridge then follows. Source-routing bridges only work with Token-Ring networks. IBM is the leading supplier of Token-Ring bridges. Other vendors including Andrew Corp. (206-485-8200), CrossComm (508-481-4060), Olicom, and Proteon also offer Token-Ring bridges.

While bridges move a lot of data between LANs and cannot cope with changes in the LAN interconnections, devices called *routers* are more selective and flexible. Routers read the destination address of each frame and determine how to send the frame toward that destination. Because they do not use MAC information, routers can connect Ethernet, Token-Ring,

or FDDI networks. Most routers can only connect LANs using the same network communications software, such as IP or IPX, although routers able to understand multiple protocols are becoming common. The most widely used multiprotocol router is built into *NetWare*. By using multiple LAN adapters in a *NetWare* file server, you can create links between LANs using software conforming to the IP, IPX, and Apple network protocols.

Recently, bridge and router technology has merged together. You can find bridge-routers, or brouters, from a number of vendors. 3Com, Cisco Systems (415-326-1941), and Wellfleet Communications (617-275-2400) all offer routers that can also perform bridging. Other vendors offer bridges that perform some form of routing.

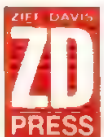
Here is our advice: If you are looking for a fast, simple, and inexpensive solution, look closely at bridges or *NetWare*'s built-in router. If you are building a complex internetwork, look at standalone routers.

A variety of different solutions are available for reaching a network while on the road or at home. The most common



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technique used to access a network remotely is controlling the action of a networked PC using modem remote-control programs, such as the \$195 *CO/Session*, from Triton Technology (908-855-9440). Remote control is practical because the calling computer sends only keystrokes, not the actual file, and the networked PC responds with screen images. This system works well with 2,400-bit-per-second modems, and the data files can stay on the network, so there is no confusion over which version of a file is current.

As the need for remote access grows, remote control of desktop PCs becomes impractical. Network managers must then establish an access server, a specialized type of communications server, for remote operation. Some access servers group a number of CPU cards in a single cabinet for efficiency and economy, such as the Chatterbox 4000, from J&L Information Systems (818-709-1778); XBUS4 (formerly Red Box), from Alloy Computer Products (800-800-2556); and the ComBridge, from Cubix Corp. (702-883-7611). Other devices, such as the Novell Access Server and the Alloy 386 MultiWare, use a multitasking environment to

**T**he task of putting together a first network can be daunting; these pointers should help.

give each caller one session of a time-shared CPU. The technique of using individual CPUs provides better reliability and responsiveness, but the cost is several times that of the shared CPU system.

Some vendors offer modems that sit directly on the network. The calling machine enters the network through a device called a *networked modem*, such as the NetModem/E, from Shiva Corp. (617-252-6300).

Each networked modem has its own network adapter and operates as a node on the network. A person using a calling PC connected through the networked modem

sees a full set of redirected drives and keeps the application's data files on the network file server.

While the task of putting together a first network can be daunting, the pointers we offer here should help. *PC Magazine* recommends that you evaluate your connectivity needs carefully: Decide what you need now and what your organization's growth will be. Smaller setups may choose printer-sharing devices, file-transfer packages, or zero-slot LANs, but we strongly advise looking into DOS-based networks. Today's powerful 386- and 486-based PCs can easily act as a file server and simultaneously run application programs. And while a standard office PC can initially provide network access to remote callers, as the need for access grows, you will probably want to move up to a device that combines remotely controlled CPUs in a single cabinet. Once you figure out what you want and need from your network, you will be well on your way to being connected. ■

*Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine. Michael Cohn is a staff editor of PC Magazine.*



## How To Get It.

Every program in the "PC/Computing Guide to Shareware" is available through ZiffNet, the on-line service all about computing. You can easily download programs from a fully indexed software library. ZiffNet also plugs you into information on what to buy, delivers industry news even before it's in print, and offers forums hosted by the editors of *PC Magazine* and *PC/Computing* to ask for advice or discuss issues. **Call 1-800-666-0330.** And remember, if you want to get into shareware, you need just two things. This guide. And ZiffNet.

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\*CompuServe and ZiffNet members type GO ZNT:PBS for direct access to the software library or type GO ZIFFNET to reach the ZiffNet main menu. © 1992 Ziff Communications.





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# 9 Multuser Databases

## Robust and Ready to Share

by Gus Venditto

Database managers that started on the PC are billing themselves as sophisticated enough to run the kinds of applications on a LAN that have required a minicomputer or mainframe. Some are up to the challenge, but others have a lot to learn about sharing.

**L**ife for a PC database manager used to be simple. *dBASE* was the standard, and sharing data was easy with a floppy disk, a modem connection, or by copying files to a network. But today, a database manager's life is a lot more complicated. Fledgling database applications have grown so large that many of those files wouldn't even fit on a floppy disk.

Today's database managers have to address problems of data integrity that spiral as the value of the data increases. There are problems of file and record contention, resulting from growth in the company and in increased pressures on the database to keep the business flourishing. And then there are performance bottlenecks that emerge when everyone tries to update the same file at the same time. These are issues that can be resolved by



client-server architectures running on mainframes, minicomputers, and PCs. Client-server databases distribute the processing and are more efficient at moving records. But you may not be ready for the steep migration costs that start with the higher prices of client-server packages and continue with the need for new programmers and training.

If your company has developed applications on standalone PCs that are now running on a network, you'll save money and be spared from aggravation by running the same database management system (DBMS) on a LAN. The question is whether the multiuser version of that DBMS will be able to keep up with your increasing demands.

### FILE SERVER-BASED DATABASES

In these reviews, we test nine PC databases that run on file servers. These products don't employ the client-server models that, in many cases, are being ported from mini- and mainframe database systems; those products will be reviewed later this year.

The products in this roundup represent the mature file-server technology that has been growing up with PCs all along. Each claims to be ready to move from the desktop to the server; this evaluation concentrates on how well they can stand up to heavy network traffic and whether they have the controls needed for workgroup applications.

Our tests do not coddle these packages. PC Magazine Labs created a battery of tests that was executed on a 24-station network and held the products up to mainframe standards. On the whole, the products rose to the challenge. When properly programmed, most of them can deliver strong performance even as network traffic grows. Many of the products maintained consistent performance as up to 24 users were added.

The performance tests used in this evaluation were adapted from the AS<sup>3</sup>AP (ANSI SQL Standard Scalable and Portable) Benchmark Tests for Relational Database Systems, developed by Carolyn Turbyfill, Dina Bitton, and Cyril Orji at Cornell University. AS<sup>3</sup>AP is a cross-platform benchmark test run here for the first time on PCs. We used the single-user tests in our last evaluation of relational databases, "15 Relational Databases: Easy Access, Programming Power" (*PC Magazine*, May 28, 1991).

The tests covered a spectrum of typical

workgroup computer chores. Some were designed to isolate performance of basic database tasks and then add heavy contention for records; we used a 24-station network to share the same 100,000-record file. On some tests, we gradually increased the number of users performing tasks and measured the change in total throughput as each new user was added. On other tests, we took performance results for a single user working without any network traffic and added seven users who made requests for records in the same data file.

The Mixed Workload test focuses most clearly on the problem of data sharing. It begins by running a series of database operations on a single station. We record the time elapsed and compute the rate of transactions per second. Then, seven more stations begin to request records from the same file. After that test, seven stations attempt to make changes to the data in the master data file. The results show what happens to that first station as network traffic—in both reads and writes—is added.

Evaluating the results requires that you look at the times posted as well as the amount of work performed; some products ran the initial workload test quickly but denied other stations access to the records. Because these products have rudimentary forms of concurrent access, they weren't sharing the data, they were hogging it. The better products allowed cooperative access to the data, thanks to

their more flexible file- and record-sharing schemes.

### THE DREADED DEADLOCK

Until recently, file sharing on a PC meant placing locks on records in an almost stranglehold. Database software ensured the integrity of data with a simple scheme: It would prevent the possible corruption of data by making sure that only one user could have access to the individual records in a file. As soon as the first user was done, the record was available to the next user—if the record was released.

As applications become heavily used, the weakness of a simplistic record-locking scheme becomes apparent: If the first user doesn't release the record in short order, other users are made to wait. When two or more users have their requests in, the threat of a deadlock exists, and everyone waits for one of the others to release a lock.

In this roundup, deadlock was a problem only for *DataEase*, which relies on an automatic record-locking scheme. *DataEase* allows you to build sophisticated applications without programming, but it provides fewer controls on concurrent access than some of the other products.

In contrast, several of these products have tools for creating basic applications but require extensive programming to get to the product's most advanced features. *KnowledgeMan*, for example, locks records when applications are created through the menu interface, creating the potential for deadlock. A programmer can work around the problem by writing routines that look for deadlock error codes and generate retries, but you need to write the code in *KnowledgeMan*'s native language. Many of the products in this roundup will retry to access locked records automatically.

### THE ACID TEST

In creating a test scenario, we used standards from the ACID (Atomicity, Consistency, Isolation, and Durability) test created by the Transaction Processing Council (TPC). It is possible to write an application in many of these nine packages that meet the criteria on the ACID test, but most of the packages would require writing code in C or assembler. *Advanced Revelation* and *R:BASE* are the only two products that make the features readily available.

Here is an overview of the four criteria for the ACID test.

### OUR CONTRIBUTORS

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Of course, Alpha FOUR is fully relational and completely menu-driven. Users simply outline their applications rather than programming them.

Alpha FOUR has gained quite a reputation for allowing users of any expertise level to design their own applications — right out of the box. Now, the long awaited upgrade version is ready to ship — and it will astound you with its new features — that still require no programming skills! Version 2 takes ease of use to a new level by allowing more productivity with less work. One of the great new features is network support. Fully Novell and NetBios compatible (including LANtastic, MainLan, LANManager, Banyan and others), Alpha FOUR Version 2 allows you to actually create networkable applications by filling in one simple screen! All file and record locking procedures are handled for you — automatically. And although many database products are networkable, only Alpha FOUR Version 2 makes it so simple.

You'll find that new Alpha FOUR Version 2 requires dramatically less memory than the previous version, and far less than its competitors. And if you're using a memory manager, Version 2 makes extensive use of extended and expanded memory for even faster performance. Even outrageously large applications and databases — that you couldn't run before — are no problem. Forget the "Out of Memory" message forever.

Indexes are an important aspect of the database. As you've probably discovered, indexes afford incredible control over your data. Alpha FOUR Version 2 now gives you that control with up to 15 indexes per database! The Alpha engineers and programmers have come up with a way to make these indexes five times faster. For example, create three indexes on a last name for your prospecting database: one for STATUS, "Hot," one for STATUS, "Warm", and a third for STATUS, "Cold". Then, when you switch your active index AlphaFOUR instantly displays only the appropriate records.

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There are two kinds of Alpha FOUR scripts. Keystroke scripts simply play back a series of keystrokes or script commands, or call another script. Dialog Scripts allow you to display information in on-screen pop-up boxes and prompt the user to enter data or choose from a list of options. You decide when and

## ALL-NEW VERSION 2



where a dialog box will appear and what choices are presented to the user. You can even control the size, color and shape of your dialog boxes... all without typing a single line of code.

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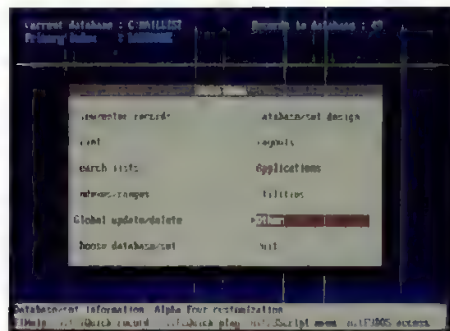
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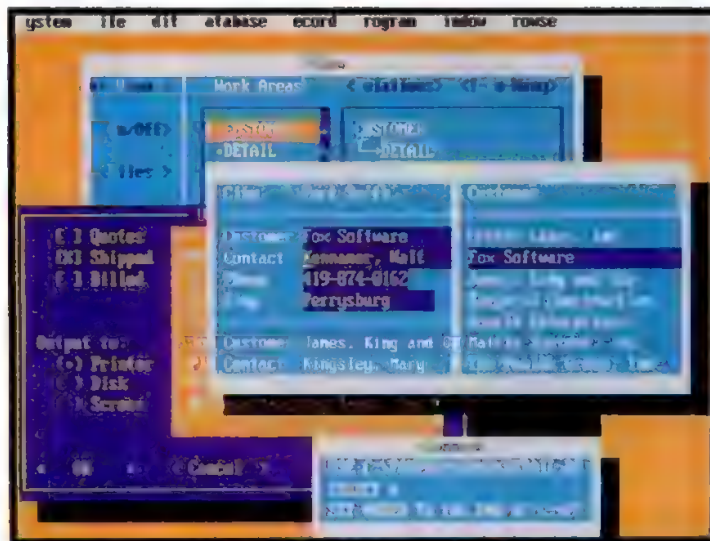
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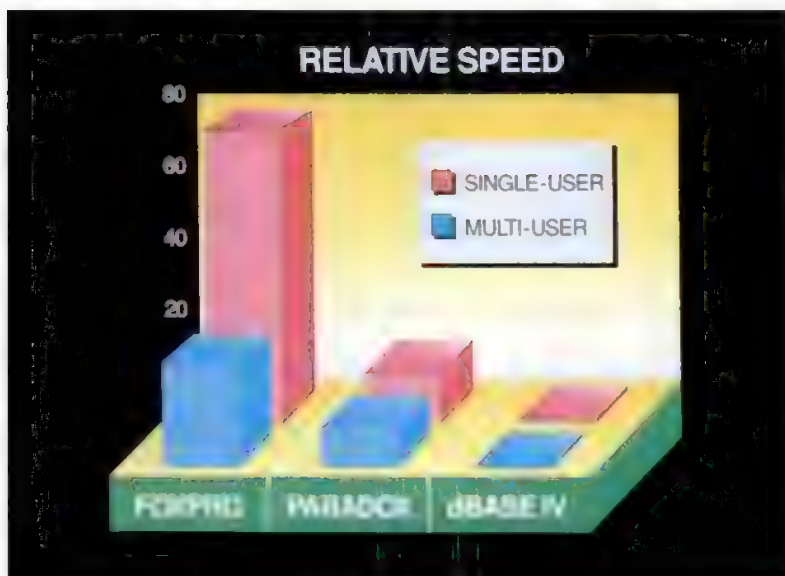
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Call 1-800-837-FOX2 or 419-874-0162 again.  
(We believe we've fixed it.)



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CIRCLE 112 ON READER SERVICE CARD



## ATOMICITY

*Atomicity* means that a transaction should be a discrete unit that performs a complete task, even though it may be comprised of a number of operations. A query or an address change are examples of simple transactions. Transactions either perform all of their constituent operations or none of them: 99 tasks out of 100 isn't good enough.

If a transaction cannot be completed, the system has to ensure that the aborted transaction had no effect on the data. This rule is the basis for the Commit and Rollback operations used in transaction processing. While executing a transaction, the system keeps track of the work in a log, including the data values affected. When the DBMS successfully completes the transaction, it commits all the changes permanently. If a transaction isn't completed successfully, the system uses the log to restore, or *rollback*, the database to its state prior to execution.

Atomicity guarantees that the database is always in a consistent state between transactions, even if an error occurs or a program aborts. A database needs true transaction processing in order to meet this requirement and, of the nine products reviewed here, only *Advanced Revelation* and *R:BASE* provide the necessary Commit and Rollback functions.

## CONSISTENCY

*Consistency* refers to data integrity. Databases organize information by breaking it down into related data elements. A database with integrity upholds rules that govern the relationships between its data elements: for example, "all employees must have a social security number"; "invoice amounts must be greater than 0"; or "whenever an amount is posted to a journal, a corresponding entry must be posted to the general ledger."

Databases are consistent when all of the data conform to the rules. Unless the DBMS has a way to enforce the rules, a database may become inconsistent after it is updated. Sometimes a complex change forces the database to be inconsistent temporarily, but in the end, order must prevail. The unit of work that takes the database from one consistent state to another is called a *transaction*.

All of the products reviewed here have validation controls that allow a database designer to ensure some consistency within an application, though not all can provide referential integrity. *Paradox* is



## SUITABILITY TO TASK

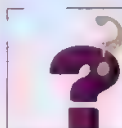
The Suitability to Task ratings for these nine databases stress multiuser features, such as shared use of files and creation of distributed applications.



**Multiuser access** reflects whether or not a choice of locking or isolation schemes is available. Top-rated products have both shared and exclusive locks and support transaction processing. The design of the product's concurrency control should not inhibit performance as the number of users increases.



**Data security** scores are higher when access to specific fields or data elements can be restricted. Rollback capability, a data dictionary, and the ability to maintain user profiles contribute to high ratings.



**Queries** ratings reward intelligent query optimization, pattern matching, and soundex capabilities. The ability to use join tables in end-user queries and the presence of a global search-and-replace feature are also important factors in this score.



**Reporting** features are rated by the program's ability to create information-rich yet readable reports. Rated features include printer support, stylesheets, leading control, font choices, text justification, and word wrapping within fields. We also consider the extent of end-user access to all reporting options.



**Applications development** scores were awarded based on the quality of the menu- and report-generation tools, the level to which the tools could be customized, and the ability to call other languages (especially C, Pascal, and assembler). The availability of code libraries and self-optimizing compilers is also important.

1—Poor

2—Fair

3—Good

4—Excellent

### Suitability to Task

#### Product name

##### Multiuser access

##### Data security

##### Queries

##### Reporting

##### Applications development

the only program with a referential integrity command; the others would require that you program it in.

## ISOLATION

*Isolation*, achieved through locking schemes, ensures that each user's access to a database record is protected while he is working on it. When a transaction locks an object, no one else may update it until the lock is released. All of the products in this review have locking schemes, and there is a wide range in the types offered.

## DURABILITY

A DBMS passes the *Durability* test if it can preserve the effects of all committed transactions and guarantee data consistency after recovering from a power outage or hardware failure. A completely reliable system will include safeguards

for the hardware, such as an uninterruptible power supply and disk mirroring. But a well-designed database application will maintain a history so that it can restore itself. To survive a brief power outage, a simple undo/redo log is all that is necessary, but to recover from a hardware failure, the system must be able to roll forward and re-create transactions from an archive. Only *Advanced Revelation* and *R:BASE* have the environment needed to ensure durability.

## ROLLING BACK AND LOOKING AHEAD

*dBASE IV* has a rudimentary rollback feature that is closer to an Undo command than a true rollback; it doesn't maintain a transaction log. *FoxPro/LAN* provides a programming interface that hooks into



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Use this form to request a quotation on the ZEOS system configuration(s) of your choice. Either Fax or mail the form to ZEOS; we will respond within 24 hours of receipt.

**FAX TO: 612-633-1325**

# Z-Quote!

**THE SYSTEM** How many systems of this configuration do you want us to quote? \_\_\_\_\_ *Note: Photo copy form for additional system configurations.*  
 Processor Type & Speed: ☐ 386SX-20 ☐ 386DX-33 ☐ 486SX-20 ☐ 486SX-25 ☐ 486DX-33 ☐ 486DX2-50 ☐ 486DX-50 ☐ 486-33 EISA  
 Amount of Memory (Megabytes of RAM): ☐ 1MB ☐ 2MB ☐ 4MB ☐ 8MB ☐ 16MB ☐ Other \_\_\_\_\_ MB  
 System Hard Disk Drive Type & Size (Megabytes): IDE Drives (MB): ☐ 40 ☐ 80 ☐ 107 ☐ 130 ☐ 210 ☐ 340 SCSI Drives (MB): ☐ 80  
☐ 155 ☐ 330 ☐ 674 ☐ 1.1GB ESDI Drives (MB): ☐ 94 ☐ 160 ☐ 338 ☐ 674 ☐ Other drive type:  
 Capacity: \_\_\_\_\_ *Note: Quoted price will include controller.* Floppy Drive(s) Desired: ☐ 1.2MB ☐ 1.44MB

**VIDEO CHOICE** ☐ ZEOS Color VGA, 14" 1024x768 Non-Interlaced ☐ ZEOS Mono VGA, 14" 64 gray scales ☐ ZEOS 14" Monochrome TTL  
☐ NEC 3FGx, 15" NI ☐ NEC 4FG, 15" NI ☐ NEC 5D ☐ other  
*Note: VGA Color and Mono options will include the Diamond SpeedStar Hi-Color card with 1MB of Video Memory and the Sierra DAC. Monochrome TTL systems include the Hercules® video card. Other video cards are optional (please specify: \_\_\_\_\_).*

**ADDITIONAL OPTIONS DESIRED** ☐ 1200 Baud Internal Modem ☐ 2400 Baud Internal ☐ 9600 Baud Internal  
☐ 2400 Baud Internal, 9600 Baud Send/Receive Fax ☐ Vertical Case, 8 bays, 300 watt TurboCool power supply, two cooling fans ☐ Tape Back-up  
☐ Math Coprocessor (included on '486 systems) ☐ On-Site Service \_\_\_\_\_ yr(s) ☐ Extended Warranty \_\_\_\_\_ yr(s) ☐ MS DOS 5.0  
☐ MS DOS 4.01 ☐ MS Windows plus Lotus 1-2-3 for Windows & Ami Pro 2.0. Adobe Type Manager (Windows systems include Lotus Software at no additional charge). ☐ other

**NOTEBOOK SYSTEMS** ☐ 286-12 ☐ 386SX-16 ☐ 386SX-20 Memory (Megabytes): ☐ 1 ☐ 2 ☐ 4 ☐ 5 ☐ 8  
 Hard Drive (Megabytes): ☐ 20 ☐ 60 ☐ 80 ☐ 120 ☐ other  
☐ Modem 2400 Baud Send/Receive Fax ☐ Extra Battery ☐ Carrying Case ☐ Math Coprocessor ☐ MS DOS 5.0 or ☐ 4.01 ☐ Windows  
☐ File Transfer Software ☐ other

**PAYMENT OPTIONS** I would like to use the following payment:  
☐ MasterCard ☐ VISA ☐ American Express ☐ Discover ☐ COD ☐ Wire Transfer ☐ Check in advance (allow 3 weeks to clear)  
 I would like to apply for: ☐ The Z-Card, my own personal ZEOS credit card ☐ A ZEOS business lease thru Bell Atlantic  
☐ I will be applying a lease thru my own lease vendor ☐ Open account with ZEOS (Fortune 1000 companies)  
*Note: We can process your request for your Z-Card or ZEOS business lease at the same time we are preparing your quotation. Simply fax or mail the appropriate completed form on the reverse side of your Z-Quote RFQ.*

**BUYER INFORMATION** This purchase is for my: ☐ personal use ☐ business use Have you purchased from ZEOS before? ☐ yes ☐ no  
 If you have a target price for this purchase please state it here; we will suggest alternatives if necessary to meet your price: \$\_\_\_\_\_ each.  
 In general what types of systems are you planning to purchase within the next 12 months? (check all that apply) ☐ desktop workstations ('386 & '486 based) ☐ file servers ☐ notebooks ☐ network nodes ☐ complete network systems Total quantity: \_\_\_\_\_  
 How many employees are in your company? ☐ 25 or less ☐ 26-99 ☐ 100-499 ☐ 500-999 ☐ 1000 or more  
 If you are considering any other brands of computers, which are they? \_\_\_\_\_

**PLEASE PROVIDE THE FOLLOWING:** How do you wish us to respond? (check all that apply)  
☐ Telephone a quote to (\_\_\_\_\_) \_\_\_\_\_ ☐ Fax a reply to (\_\_\_\_\_) \_\_\_\_\_  
☐ Send a written quotation to the address below

Name: \_\_\_\_\_ Title: \_\_\_\_\_ Company: \_\_\_\_\_  
 Phone (days): (\_\_\_\_\_) \_\_\_\_\_ (evenings if applicable): (\_\_\_\_\_) \_\_\_\_\_  
 Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_



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UNITED STATES

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ST. PAUL, MINNESOTA 55112-9960





**APPLY NOW FOR YOUR Z-CARD!**■ **Low Consumer Rate!** ■ **No Annual Fee!**

Now you can send for your own ZEOS Credit Card. It works just like a MasterCard or Visa for ZEOS purchases.

Fax to: 612-486-1957 or mail to: **ZEOS International, Z-Card Processing Center, 530 5th Avenue N.W., St. Paul, MN 55112.** We'll call as soon as your credit line is established!\*

**Z-Card!**<sup>TM</sup>**A. YOUR PERSONAL INFORMATION**

Please complete all appropriate sections, *providing at least two years residence and employment history. THIS IS NOT A CREDIT AGREEMENT!* One will be sent to you upon authorization of an account. (This Form Must Be Signed To Process Your Order.) All Financed Purchases Are Subject To Credit Approval. *If You Have Any Credit Questions, Please Call 800-421-8942 For Assistance.* Thank You!

Name \_\_\_\_\_ Previous Address \_\_\_\_\_  
 Home Phone (\_\_\_\_\_) \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Soc. Sec. No. \_\_\_\_\_ Date of Birth \_\_\_\_/\_\_\_\_/\_\_\_\_ Employer \_\_\_\_\_ Since? (Mo./Yr.) \_\_\_\_\_  
 Address \_\_\_\_\_ Apt. \_\_\_\_\_ Monthly Gross Salary \$ \_\_\_\_\_ Daytime Bus. Phone (\_\_\_\_\_) \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_ Previous Employer \_\_\_\_\_ From \_\_\_\_\_ To \_\_\_\_\_  
 Since? (Mo./Yr.) \_\_\_\_\_ ☐ Buy ☐ Rent ☐ Other \_\_\_\_\_ Occupation \_\_\_\_\_

A married person may apply for individual credit. I am applying for (please check appropriate box):

☐ **JOINT CREDIT** with another person. Complete entire application.

☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.

☐ **INDIVIDUAL CREDIT.** Do not complete Section C.\*\*

\*\*If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

**NOTICE TO WISCONSIN APPLICANTS:**  
**YOU MUST DISCLOSE YOUR MARITAL STATUS:**

☐ married ☐ unmarried ☐ legally separated

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying this obligation.

Additional Monthly Income \$ \_\_\_\_\_ Source: \_\_\_\_\_

Name & Address of Nearest Relative Not Living With You \_\_\_\_\_

Relationship \_\_\_\_\_

**B. CREDIT INFORMATION**

PLEASE TELL US IF YOU HAVE:

Checking Account ☐ Yes ☐ No

Savings Account ☐ Yes ☐ No

|                      | Y/N   | How Many? |                          | Y/N   | How Many? |
|----------------------|-------|-----------|--------------------------|-------|-----------|
| Bank Loan            | _____ | _____     | Dept. Store Charge Card  | _____ | _____     |
| VISA                 | _____ | _____     | Credit Union Account     | _____ | _____     |
| MasterCard           | _____ | _____     | Other Major Charge Cards | _____ | _____     |
| Finance Company Loan | _____ | _____     |                          |       |           |

**C. JOINT APPLICANT INFORMATION**

Joint Applicant's Name \_\_\_\_\_

Soc. Sec. No. \_\_\_\_\_ Date of Birth \_\_\_\_/\_\_\_\_/\_\_\_\_

Address \_\_\_\_\_ Apt. \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Home Phone (\_\_\_\_\_) \_\_\_\_\_ Date of Residence (Mo./Yr.) \_\_\_\_\_

Joint Applicant's Employer \_\_\_\_\_ Since? (Mo./Yr.) \_\_\_\_\_

Bus. Phone (\_\_\_\_\_) \_\_\_\_\_ Monthly Gross Salary \$ \_\_\_\_\_

**CUSTOMER AUTHORIZATION**

I authorize ZEOS International, Ltd. or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct to the best of my knowledge and belief.

Applicant's Signature \_\_\_\_\_

Date \_\_\_\_\_

Joint Applicant's Signature \_\_\_\_\_

Date \_\_\_\_\_

**FOR MARRIED WISCONSIN APPLICANTS:**

I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

Buyer's Signature \_\_\_\_\_

Date \_\_\_\_\_

There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 800-421-8942 or 612-635-0613 or write to ZEOS, Z-Card Processing Center, 530 5th Avenue N.W., St. Paul, MN 55112.

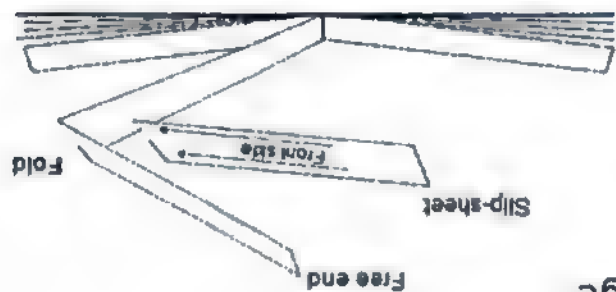
NY—A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

OH—The Ohio laws against discrimination require that all creditors make credit equally available to all creditworthy customers and that credit reporting agencies maintain separate credit histories on each individual upon request. The Ohio Civil Rights Commission administers compliance with this law.

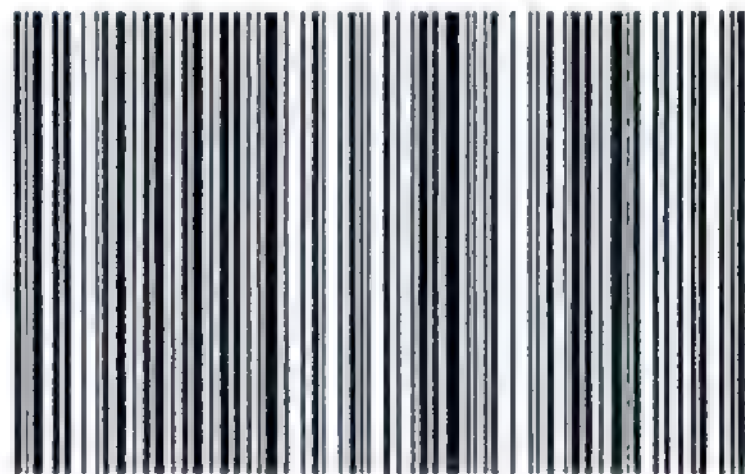
\*Financing not available in Alaska, Hawaii or outside the continental U.S.

**FAX TO: 612-486-1919**

1. Open the foldout page
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



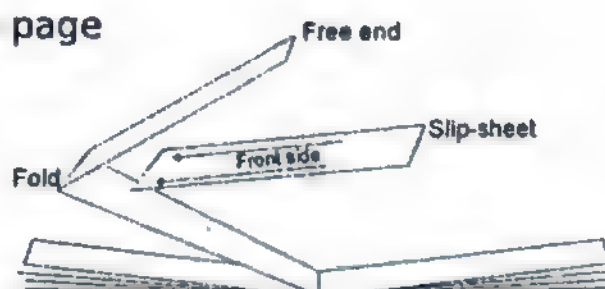
### Foldout slip-sheet



Folded edge of the page

### Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
  1. Front side touching the free page
  2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

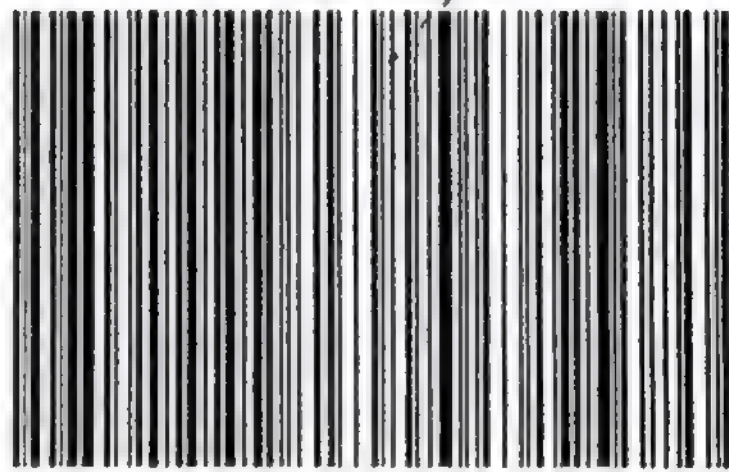




1. Follow instructions on the other side

Back

Gbs5lipBack-0018



Inverted Back

1. Follow instructions on the other side

**YOUR ZEOS QUOTE REQUEST: FAX OR MAIL!**

Use this form to request a quotation on the ZEOS system configuration(s) of your choice. Either Fax or mail the form to ZEOS; we will respond within 24 hours of receipt.

**FAX TO: 612-633-1325**

# Z-Quote!

**THE SYSTEM** How many systems of this configuration do you want us to quote? \_\_\_\_\_. *Note: Photo copy form for additional system configurations.*

Processor Type & Speed: ☐ 386SX-20 ☐ 386DX-33 ☐ 486SX-20 ☐ 486SX-25 ☐ 486DX-33 ☐ 486DX2-50 ☐ 486DX-50 ☐ 486-33 EISA

Amount of Memory (Megabytes of RAM): ☐ 1MB ☐ 2MB ☐ 4MB ☐ 8MB ☐ 16MB ☐ Other \_\_\_\_\_ MB

System Hard Disk Drive Type & Size (Megabytes): IDE Drives (MB): ☐ 40 ☐ 80 ☐ 107 ☐ 130 ☐ 210 ☐ 340 SCSI Drives (MB): ☐ 80

☐ 155 ☐ 330 ☐ 674 ☐ 1.1GB ESDI Drives (MB): ☐ 94 ☐ 160 ☐ 338 ☐ 674 ☐ Other drive type:

Capacity: \_\_\_\_\_ *Note: Quoted price will include controller.* Floppy Drive(s) Desired: ☐ 1.2MB ☐ 1.44MB

**VIDEO CHOICE** ☐ ZEOS Color VGA, 14", 1024x768 Non-Interlaced ☐ ZEOS Mono VGA, 14" 64 gray scales ☐ ZEOS 14" Monochrome TTL

☐ NEC 3FGx, 15", NI ☐ NEC 4FG, 15", NI ☐ NEC 5D ☐ other

*Note: VGA Color and Mono options will include the Diamond SpeedStar Hi-Color card with 1MB of Video Memory and the Sierra DAC.*

Monochrome TTL systems include the Hercules® video card. Other video cards are optional (please specify: \_\_\_\_\_).

**ADDITIONAL OPTIONS DESIRED** ☐ 1200 Baud Internal Modem ☐ 2400 Baud Internal ☐ 9600 Baud Internal

☐ 2400 Baud Internal, 9600 Baud Send/Receive Fax ☐ Vertical Case, 8 bays, 300 watt TurboCool power supply, two cooling fans ☐ Tape Back-up

☐ Math Coprocessor (included on '486 systems) ☐ On-Site Service \_\_\_\_\_ yr(s) ☐ Extended Warranty \_\_\_\_\_ yr(s) ☐ MS DOS 5.0

☐ MS DOS 4.01 ☐ MS Windows plus Lotus 1-2-3 for Windows & Ami Pro 2.0. Adobe Type Manager (Windows systems include Lotus Software at no additional charge). ☐ other

**NOTEBOOK SYSTEMS** ☐ 286-12 ☐ 386SX-16 ☐ 386SX-20 Memory (Megabytes): ☐ 1 ☐ 2 ☐ 4 ☐ 5 ☐ 8

Hard Drive (Megabytes): ☐ 20 ☐ 60 ☐ 80 ☐ 120 ☐ other

☐ Modem 2400 Baud Send/Receive Fax ☐ Extra Battery ☐ Carrying Case ☐ Math Coprocessor ☐ MS DOS 5.0 or ☐ 4.01 ☐ Windows

☐ File Transfer Software ☐ other

**PAYMENT OPTIONS** I would like to use the following payment:

☐ MasterCard ☐ VISA ☐ American Express ☐ Discover ☐ COD ☐ Wire Transfer ☐ Check in advance (allow 3 weeks to clear)

I would like to apply for: ☐ The Z-Card, my own personal ZEOS credit card ☐ A ZEOS business lease thru Bell Atlantic

☐ I will be applying a lease thru my own lease vendor ☐ Open account with ZEOS (Fortune 1000 companies)

*Note: We can process your request for your Z-Card or ZEOS business lease at the same time we are preparing your quotation. Simply fax or mail the appropriate completed form on the reverse side of your Z-Quote RFQ.*

**BUYER INFORMATION** This purchase is for my: ☐ personal use ☐ business use Have you purchased from ZEOS before? ☐ yes ☐ no

If you have a target price for this purchase please state it here; we will suggest alternatives if necessary to meet your price: \$\_\_\_\_\_ each.

In general what types of systems are you planning to purchase within the next 12 months? (check all that apply) ☐ desktop workstations ('386 & '486 based) ☐ file servers ☐ notebooks ☐ network nodes ☐ complete network systems Total quantity: \_\_\_\_\_

How many employees are in your company? ☐ 25 or less ☐ 26-99 ☐ 100-499 ☐ 500-999 ☐ 1000 or more

If you are considering any other brands of computers, which are they? \_\_\_\_\_

**PLEASE PROVIDE THE FOLLOWING:** How do you wish us to respond? (check all that apply)

☐ Telephone a quote to (\_\_\_\_\_) \_\_\_\_\_ ☐ Fax a reply to (\_\_\_\_\_) \_\_\_\_\_

☐ Send a written quotation to the address below

Name: \_\_\_\_\_ Title: \_\_\_\_\_ Company: \_\_\_\_\_

Phone (days): (\_\_\_\_\_) \_\_\_\_\_ (evenings if applicable): (\_\_\_\_\_) \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_



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ST. PAUL, MINNESOTA 55112-9960





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Get the power you need today at the lowest monthly payment possible! Mail or Fax this application to ZEOS. As soon as you've chosen your system, your application will be processed for approval. Questions? Call 800-423-5891.

**FAX TO: 612-486-1919**

Lease agreements are limited to commercial business accounts only.

# Z-Lease!

### LEASE APPLICATION

Lessee Full Company Name \_\_\_\_\_

No. of Years in Business \_\_\_\_\_

Address \_\_\_\_\_

Equipment Cost \_\_\_\_\_

City/State/Zip \_\_\_\_\_

Equipment Description \_\_\_\_\_

Telephone No./Contact Person \_\_\_\_\_

Lease Term \_\_\_\_\_

Business Structure: ☐ Proprietorship ☐ Partnership ☐ Corporation

Monthly Amount \_\_\_\_\_

☐ Security Deposit Amount \$ \_\_\_\_\_

Type of Business \_\_\_\_\_

Purchase Option: ☐ \$100 ☐ 10%

Guarantor information required for all corporations in business less than two years, and all partnerships or proprietors.

### PERSONAL DATA

Name \_\_\_\_\_

Soc. Sec. No. \_\_\_\_\_

Home Address \_\_\_\_\_

Background Information 1 \_\_\_\_\_

Soc. Sec. No. \_\_\_\_\_

Background Information 2 \_\_\_\_\_

Name \_\_\_\_\_

Home Address \_\_\_\_\_

### REFERENCES

List bank or banks; previous bank required if applicant has been at present bank less than two years.

Loan/Lease/Trade References:

Present Bank of Applicant \_\_\_\_\_

Name \_\_\_\_\_

Branch \_\_\_\_\_

Address \_\_\_\_\_

Phone \_\_\_\_\_

Phone \_\_\_\_\_ Contact \_\_\_\_\_

Name of Bank Officer \_\_\_\_\_

Name \_\_\_\_\_

Account No. \_\_\_\_\_

Address \_\_\_\_\_

Previous or Second Bank of Applicant \_\_\_\_\_

Phone \_\_\_\_\_ Contact \_\_\_\_\_

Branch \_\_\_\_\_

Name \_\_\_\_\_

Phone \_\_\_\_\_

Address \_\_\_\_\_

Name of Bank Officer \_\_\_\_\_

Phone \_\_\_\_\_ Contact \_\_\_\_\_

Account No. \_\_\_\_\_

I authorize the release of any credit or financial information to Bell Atlantic TriCon Leasing Corporation.

Signature \_\_\_\_\_

Notice: If your application for business credit is denied, you have the right to a written statement of the specific reasons for the denial. To obtain the statement, please contact the lessor named herein within 60 days from the date you are notified of our decision. We will send you a written statement of reasons for the denial within 30 days of receiving your request for the statement.

The Federal Equal Credit Opportunity Act prohibits creditors from discriminating against credit applicants on the basis of race, color, religion, national origin, sex, marital status, age (provided the applicant has the capacity to enter into a binding contract); because all or part of the applicant's income derives from any public assistance program, or because the applicant has in good faith exercised any right under the Consumer Credit Protection Act. The federal agency that administers compliance with this law concerning this creditor is Federal Trade Commission, ECOA Compliance, Washington, DC 20581.

**FAX TO: 612-486-1919**

ZEOS Friends, here are your approximate monthly Z-Card & Z-Lease payments for ZEOS system packages advertised on pp. 145-156 of this issue. Your actual payments will depend on the specific configuration you order. Why not apply right now!

# ZEOS. Get a Quote, Get a Card, Get a Lease!

Now, ZEOS makes it even easier for you to buy!

## WITH THE ACCOMPANYING FORMS YOU CAN:

**Request a quotation.** Use the Z-Quote request form to receive a complete quotation on your new system requirements. Whether your form is faxed or mailed back to us, we will respond within 24 hours of receipt. Fast Quotes of Fast ZEOS systems!

**Apply for a Lease.** Businesses can apply for a Bell Atlantic lease using our lease request form. Once you know the system you want, we'll process your application and get an answer back to you, usually no more than 24 hours later. And what's more, our rates are low, low, low! Unlike most of the others, we don't add anything for ourselves to the lease rate. Dollar for dollar your leased ZEOS system will probably cost you less than the others. Shop and compare!

**Apply for your own Z-Card.** For individuals, ZEOS offers the Z-Card; it works just like a MasterCard or VISA for ZEOS purchases. Your Z-Card also has low consumer rates and no annual fee. We'll process your Z-Card

application as soon as it's received and call you back as soon as your credit line is established — usually within 24 hours! Apply for your Z-Card by Fax, mail, or call 800-421-8942.

If any of the applications have been removed from this magazine, call 800-423-5891 and we'll fax or mail one to you immediately. Apply today!

## Desktop System Packages

|                         | Package #1 | Package #2 | Package #3 | Package #4 |
|-------------------------|------------|------------|------------|------------|
| <b>386SX-20</b>         | \$1195     | \$1395     | \$1795     | \$1995     |
| Monthly Lease Payments  | 53         | 61         | 67         | 68         |
| Monthly Z-Card Payments | 38         | 44         | 56         | 62         |
| <b>386DX-33</b>         | \$1395     | \$1895     | \$2395     | \$2895     |
| Monthly Lease Payments  | 61         | 71         | 89         | 107        |
| Monthly Z-Card Payments | 44         | 59         | 74         | 90         |
| <b>486SX-20</b>         | \$1595     | \$2095     | \$2595     | \$3095     |
| Monthly Lease Payments  | 60         | 78         | 96         | 108        |
| Monthly Z-Card Payments | 50         | 65         | 80         | 96         |
| <b>486SX-25</b>         | \$1695     | \$2195     | \$2695     | \$3195     |
| Monthly Lease Payments  | 64         | 82         | 100        | 108        |
| Monthly Z-Card Payments | 53         | 68         | 83         | 99         |
| <b>486DX-33</b>         | \$1795     | \$2295     | \$2795     | \$3295     |
| Monthly Lease Payments  | 67         | 85         | 104        | 111        |
| Monthly Z-Card Payments | 56         | 71         | 87         | 102        |
| <b>486DX-50</b>         | \$1995     | \$2495     | \$2995     | \$3495     |
| Monthly Lease Payments  | 74         | 93         | 108        | 118        |
| Monthly Z-Card Payments | 62         | 77         | 93         | 108        |
| <b>486DX-50</b>         | \$2195     | \$2695     | \$3195     | \$3695     |
| Monthly Lease Payments  | 82         | 100        | 108        | 125        |
| Monthly Z-Card Payments | 68         | 83         | 99         | 114        |



NetWare's transaction tracking system, but it wasn't working when we prepared this review.

With multiuser databases taking on ever more critical applications, it's certain that transaction processing features will become more common. In choosing a multiuser database system today, you have a good range of robust systems to choose from. By adding new security and concurrency controls to these versions, PC multiuser databases have made it possible to build applications that allow true data sharing and hold up to heavy network traffic. They provide a wide range of tools for making sure that the right people get to data when they need it, and that tools for querying, reporting, and updating are easy to use. Compare them with a minicomputer system for the same application, and you can count the savings in hundreds of thousands of dollars.



## EDITORS' CHOICE

■ Four honorable mentions

There is such a diversity in the features and approaches to data management in these nine products that a single Editors' Choice would not do justice to the options available. None of the products stood out in all the respects we considered important, especially concurrent data access, performance under a heavy workload, and a rich set of data management features. Four products are worthy of merit, but each has limitations.

*R:BASE* demonstrated such an excellent range of data-sharing options that it should be strongly considered by anyone building a mission-critical application on a PC network. It was the only program in this roundup that made transaction-processing features available without programming, and its concurrency controls made shared access to records smooth, even under heavy network contention. *R:BASE*, however, was one of the slowest performers in almost every case.

In building an application that is based on *dBASE* code and where security is not a paramount concern, *FoxPro/LAN* would make an excellent choice. It is extremely fast at handling queries, and while it has tools for handling just about any type

## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES

### Advanced Revelation

**BY HENRY FERSKO-WEISS** *Advanced Revelation*, Version 2.11, is not for the average database user. It requires solid programming skills and the patience to learn a bewildering array of menu-driven tools. You'll also have to put up with the program's slow speed for many operations.

If you intend to design complex applications, however, particularly ones with varied record lengths, then *Advanced Revelation* may be just the program to meet your needs. It comes with a powerful BASIC-like programming language and several other languages for querying data and for writing reports. And every field of information, regardless of data

of multiuser application you might need, it also has a solid user interface. *FoxPro/LAN* should, however, have better internal locking and should not require that you write C or assembler programs to access transaction-processing features.

We were also impressed with *Superbase 4*, which provides full graphics capabilities with a powerful set of concurrency controls. Microsoft Windows is required and security controls may not be rigid enough for some applications, but *Superbase 4* turned in relatively good performance on many of our tests. It has an optional module for accessing SQL data, uses DDE, and has an internal communications facility for automating data transfer.

*KnowledgeMan* displayed a strong mix of performance and multiuser features, including shared access to records. But you will need to delve into the product's native language to get to that power—which may be well worthwhile, since the features are so rich. For example, an application can display a graphics image when running in text mode during a query. Since *KnowledgeMan*'s source code is available, programmers can add functions to the user interface.

## Suitability to Task Advanced Revelation



type, has a variable length.

*Advanced Revelation*'s interface resembles an old-time carpenter's toolbox. You can find a tool—or a variety of tools—to do almost anything. But in order to find the tool or procedure you need, you may have to search menus and scroll your way through a number of lists. For example, you can use three basic types of indexing—Btrieve, Cross Reference, or Relational—or you can use Quickdex, a sorted list of keys assigned to a file. You can perform an index from a menu located under Files on the Tools menu or from the Paint menu or the dictionary window using soft keys. Such a wide variety of options makes the program difficult to learn. On-line help lessens the problem, but even here you may be overwhelmed. There are five types of help—including concept, context, and soft-key—accessed via different function keys and Ctrl-key combinations.

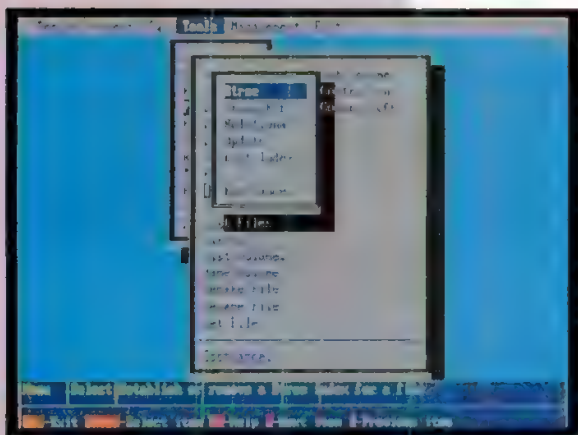
If you have the time to master all this complexity, *Advanced Revelation* gives you great control over your applications. You can even alter the way the system itself operates if you have the courage to replace the program's operating routines with your own; you write these routines with the R/BASIC programming language.

## TRANSACTION PROCESSING

For multiuser applications and environments, *Advanced Revelation* offers users the benefits of transaction processing through the use of *commits* and *rollbacks*. It also provides good security measures by letting you use passwords and restriction levels to protect files by account and through individual windows within your applications. The R/BASIC feature gives you the ability to write code to protect



## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES



**Advanced Revelation** has a large arsenal of powerful tools that make it well suited for use on a LAN, but you have to wade through several layers of menus to get to many of them.

records and fields via passwords.

Another useful multiuser feature in the program is *environmental bonding*, which lets you read and update data from other database managers, spreadsheets, word processors, database servers, mainframes, and minicomputers. Environmental bonding gives you direct access to data in the native format of each application. These files can be shared with users working in other environments. *Advanced Revelation* supplies bonds for dBASE III and ASCII files, and third-party vendors have written bonds for a number of other programs.

One poor aspect of *Advanced Revelation*'s multiuser profile is the program's performance. On PC Magazine Labs' tests, the program came in last for loading and indexing files, taking over 17 hours (the

average loading and indexing time for all programs was about 7 hours). *Advanced Revelation* also could not complete the report test within the 5-hour time limit, and only one other program failed this test. On the other tests, *Advanced Revelation* fared somewhat better, though its performance usually fell just below average.

### VARIABLE-LENGTH FIELDS

*Advanced Revelation* uses variable-length fields for all data, so you don't have to concern yourself with field lengths. This saves disk space and is ideal for situations where varied data is the norm, such as legal and human-services applications. When you do set lengths on the data-entry form, it controls only the amount of data that is seen without scrolling.

At the prompt window for each data field you can define default values and data patterns, specify sequential incrementing, and edit masks. The process involves filling in a form and possibly adjusting a set output pattern or format. When you're finished with a form you can resize it and then position it anywhere on the screen quite easily.

*Advanced Revelation* relies on calculated fields to get totals on a form, to extract data from another file, to direct entered data to different files, and so on. You have to use formulas to perform these calculations, and those formulas can contain up to 32K of R/BASIC programming. A pick list-driven formula builder helps you do this without using a command line, but the process still requires a good understanding of programming logic.

As you create data entry forms, the program will create the data dictionary items and the data file for you. You can then test your form without entering actual data. Other tools let you create pop-up list boxes, menus, help windows, custom queries, and reports.

Pieces of applications built with the menu-driven tools tend to function slowly. These tools should be used mainly for prototyping and getting a basic application up and running quickly. In order to optimize application throughput, you'll have to replace module calls with refined

R/BASIC programming code.

Unlike many other high-level database programs with tools for the end user, *Advanced Revelation* forces you to use the internal programming language at some point to get efficient applications. And many developers will eschew the tools altogether in favor of using R/BASIC. While R/BASIC has a great deal of power, its program code tends to be longer than in other languages to accomplish the same tasks.

If you want a database program that runs quickly and makes it easy to design applications, look elsewhere. But if you need excellent flexibility and application-building power in your database, and you can tolerate its steep learning curve, then you should at least take a look at *Advanced Revelation*.

## DataEase

**BY ALFRED POOR** *DataEase*, Version 4.2, makes it easy to create complex applications, and it's especially suited to applications you use to relate multiple tables of data in sophisticated ways. It's also helpful if you want tools for automating frequently performed operations. With *DataEase* you can have all you need without sacrificing the ability to make ad hoc query tools accessible to nontechnical users. The biggest benefit of *DataEase* is that you aren't required to write any program code: All you have to do is fill in the blanks and make choices from menus.

The program may sound simplistic, but that is far from the case. *DataEase* has capacities equal to its competitors, or at least large enough so that most applications are not at risk of bumping up against them. It can handle up to 255 fields per



### Advanced Revelation, Version 2.11

Revelation Technologies Inc., 2 Park Ave., New York, NY 10016; 800-262-4747, 212-689-1000.

**List Price:** \$1,195.

**Requires:** 640K RAM, 5MB hard disk space, DOS 3.1 or later.

**In Short:** *Advanced Revelation* comes with quite a few application-building tools, but the resulting applications are slow unless you redesign elements using the internal R/BASIC programming language. The power and flexibility of R/BASIC and the program's variable-length fields make it worth looking at if you are a competent programmer or serious developer.

CIRCLE 489 ON READER SERVICE CARD



### DataEase, Version 4.2

DataEase International Inc., 7 Cambridge Dr., Trumbull, CT 06611; 800-243-5123, 203-374-8000.

**List Price:** \$795; 5-user workstation pack, \$1,095; DataEase Developer 4.2 (unlimited runtime license), \$795.

**Requires:** 640K RAM, 1.4MB hard disk space, DOS 3.1 or later.

**In Short:** Within its limitations, *DataEase* is an excellent tool for creating robust and complex applications with a minimum of time and effort.

CIRCLE 490 ON READER SERVICE CARD



record, 2,000 tables per database, 16 million records per table, and 32 million records per database.

*DataEase* supports most popular LAN operating systems and can support up to 1,024 users, though our test results indicate that it may not be your best choice if you have many workstations applying heavy and constant loads on your network.

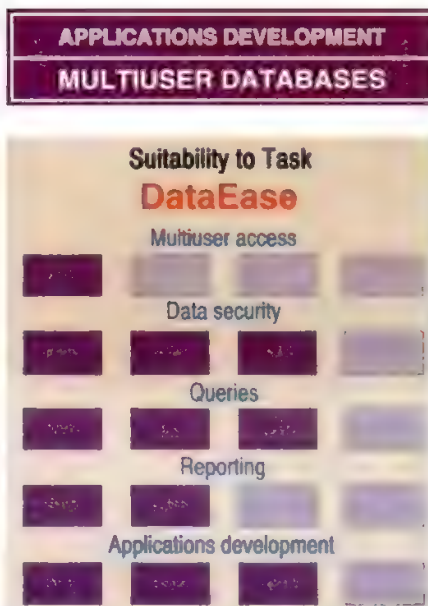
#### AUTOMATIC RECORD LOCKING

One characteristic that sets *DataEase* apart from most other multiuser database programs is that it provides almost all file and record locking automatically. You can choose among a number of different multiuser settings—such as automatic screen refresh—using data entry screens for system configuration, and the program does the rest.

If you need to lock a record or table explicitly, there are commands for that, but you will not need them for general use. One side benefit of the program's automatic locking is that you can take a database application created for single-user installation of *DataEase*, and it will run safely without any changes on a multiuser system.

On the other hand, the automatic locking has limitations and some negative side effects as well. For example, *DataEase* was unable to pass PC Magazine Labs' Deadlock Recovery test (though it did pass our other two concurrency tests without a problem). Also, the automatic locking created unnecessary contention for database resources while running the Information Update procedure on the network workstations, which resulted in unusually low numbers of iterations per station over a period of time.

Another special feature in *DataEase* is the maintenance of all database elements in a series of related DOS files, but the program accesses them as a whole. If you have a table with client names and addresses in one database and you want the same information to be available in another database, you have to transfer it by creating a new copy. This has some significant security benefits, since it means that users can gain access only to the data in a table by accessing the database as a whole. As a result, you cannot circumvent the system's security features by working directly with the data files, as is the case with some of its competitors. (*DataEase* also offers an optional program called *DataEase Developer* that allows you to



encrypt applications to prevent modification, as well as provides a runtime version that can be used to distribute turnkey applications.)

It is simple to create links between related tables and then use the connection for validation, lookups, and updates of related records. *DataEase* passed our Referential Integrity test, but this only works when you have a data entry form defined where the related table is displayed as a subform on the same screen.

One important aspect of any *DataEase* application is reporting. Reports are used for everything from ad hoc queries to creating complex transaction procedures (although it does not have transaction processing facilities such as commit and rollback).

#### QUICK REPORTS

Quick reports can be created by filling in blanks on the normal data entry screen. These can be quickly converted to a formal report procedure based on the *DataEase* Query Language (DQL). Queries are created using a unique prompting system that can provide two levels of complexity depending on the user's ability and needs, or you can enter the query code directly and *DataEase* will verify it for syntax and other errors before letting you save it—virtually eliminating the problem of writing procedures that will not run.

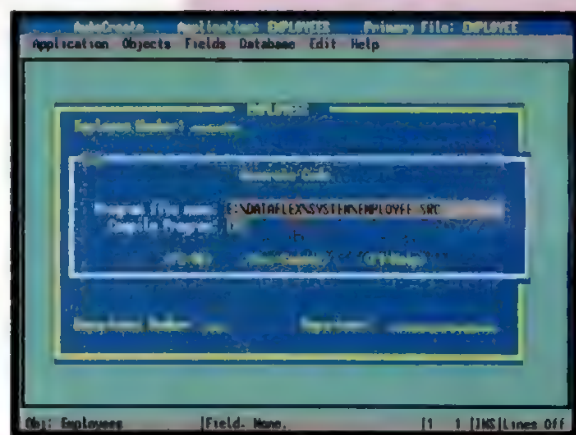
The formatting portion of the report generator makes it a snap to create headers, footers, group headers, trailers, and

other handy details. Virtual fields and system data such as time and date are also easy to create and use in reports. There is solid support for a wide range of printers, and you can also easily route output to screen or a disk file.

*DataEase* provides multiple levels of security, which can be used to limit access not only to tables, but to individual fields as well. There are different rights for view and write. The same security levels can be used to control access to custom menus, which in turn can easily be used to limit the areas of the database that a given user can see or modify.

*DataEase* handles data import and export with relative ease. It supports *Lotus 1-2-3*; *dBASE II, III, and IV*; *.DIF* files; and various text file formats including fixed-length and delimited. You can specify your own record delimiter. In some cases, *DataEase* is able to match the import data to different fields in the database table, but in others, the receiving table's structure must match the import data. You export data using the report formatter, which can create fixed-length or delimited text files, *Lotus 1-2-3*, *.DIF*, and files in mail-merge formats for *MultiMate*, *WordPerfect*, and *WordStar*.

Aside from its ability to import data, *DataEase*, Version 4.2, does not interact well with other systems. *DataEase* procedures are in a unique format, and there is no way to export or convert the applications to other program formats.



*DataEase* relies on data entry screens for a variety of configuration settings, including controls for different users' access to records as shown here. One setting that can usually be left alone is locking; *DataEase* automatically locks open files.



Unfortunately, *DataEase*'s newest release, Version 4.5, was not ready in time for these tests. In addition to improved network performance, this new product also offers the ability to act as a front end for SQL servers (via a separate \$495 driver) and to allow calls to external procedures written in other languages such as C.

*DataEase* could benefit from the reported performance improvements of its new product, because *DataEase* did not fare particularly well on our tests. It failed to complete the Report test within the time limit, and its contention problem relegated it to the back of the pack on the Random Writes test. It fell into the second half of the pack on most of the tests.

*DataEase* is a powerful and attractive program that has its limitations. If you need to create fairly complex applications with a minimum of time and effort, it is one of the fastest development systems available. Its limits become apparent on a large, heavily used network where it slows down, and it can have problems resolving deadlocks. For many applications on smaller networks, however, it is a good choice.

## DataFlex

**BY JOE SALEMI** The best way to describe Data Access Corp.'s *DataFlex*, Version 3.0, is to call it a database programmer's toolkit. Tools for the end user are minimal, except for a module available at additional cost, and virtually every aspect of an application must be programmed. While the resulting application is fast and has the advantage of being compatible across a number of operating systems, *DataFlex* suffers from the lack of built-in user security. There are also two mutually exclusive approaches to creating programs, which only serve to make an already complex system even more difficult to use.

Unlike most multiuser databases, the LAN version of *DataFlex* (\$1,450) automatically supports unlimited users; no additional bump disks are required. Extended support is available only for *NetWare* 2.15 or later and *LANtastic* 3.03 or later. Data Access representatives stated that this version should work on other LANs that provide DOS 3.x file locking, but they don't guarantee it.

In counterbalance, *DataFlex*, 2.3b

and other versions are available for DOS, Unix, AIX, Xenix, VMS, and OS/2; applications written and compiled under one version are compatible with other versions—a definite plus for those who share applications across a number of in-house systems. Version 3.0 has numerous enhancements over 2.3b, and Data Access is in the process of upgrading non-DOS versions to this level.

### ADD YOUR OWN SECURITY

Unfortunately, *DataFlex* has no built-in user security and relies entirely on the security provided by the operating system. User- or field-level security must be completely programmed by the applications developer and by using different forms and reports for different users. Some data security is provided by *DataFlex*'s option to compress the proprietary format data files automatically, reducing the ability to read them with a byte-level disk editor. Applications are also distributed in precompiled format, eliminating the user's ability to examine and change the source code.

Concurrency controls are handled automatically under certain circumstances, but they must be programmed under others. Multiple writes are handled by locking the record or records being updated and by storing the information in a reread buffer that's written to the database only on a save command; all locks are then removed. There are no built-in retry capa-

bilities, so users cannot access locked records and automatic retries have to be written as part of the application. While this method completely prevents deadlocks, it also has a bad side effect: There's no protection for data consistency because batch functions don't lock the entire file unless the application specifically does so, and an update can take effect between runs of the report, changing the results. *DataFlex* has no built-in transaction-processing capabilities.

Automatic buffering of writes had a noticeable effect on updates performed by multiple workstations. *DataFlex* had the highest number of transactions per second on our Random Writes tests, and throughput was hardly affected as more stations were added. A slowdown was evident during the Mixed Workload and Report tests, though across all tests its performance was a bit better than average in comparison to the other tested machines.

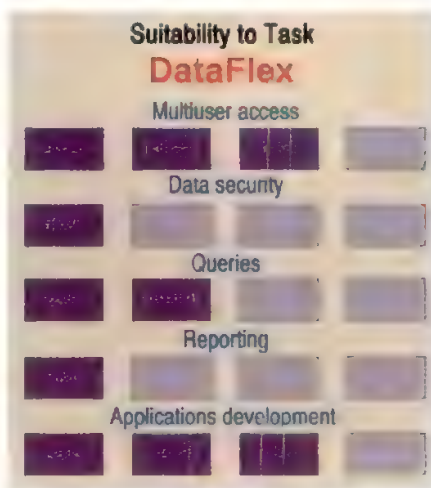
Other than its own compatibility across different operating systems (discussed previously), *DataFlex* has little support for other databases. It can only import fixed-record or comma-delimited ASCII files, limiting its appeal for those looking to convert existing databases. Other formats can be imported through custom programs, but this process can be complex and requires a working knowledge of different file structures.

### OBJECT-ORIENTED PROGRAMMING

The *DataFlex* programming environment consists of a number of separate modules,



**DataFlex's User Interface**  
Management System provides a CUA (common user access) environment for both database access and applications development.







## FACT FILE

### DataFlex, Version 3.0

Data Access Corp., 14000 S.W. 119th Ave.,  
Miami, FL 33186; 305-238-0012.

**List Price:** Single user, \$795; unlimited  
networked users, \$1,450

**Requires:** 450K RAM, hard disk, DOS 3.1 or  
later.

**In Short:** DataFlex is a complex database  
environment designed more for programmers  
than end users. The lack of built-in security  
and reporting facilities limits its usefulness in  
business environments.

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## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES

other databases limits its usefulness; *DataFlex* is recommended only for those who have the various systems that it supports or who are looking for a database package common to all of them.

## *dBASE IV, Server Edition*

**BY JOE SALEMI** From its origins on CP/M systems to the present, *dBASE* has been considered the standard PC database package. Borland International's *dBASE IV*, Version 1.1, Server Edition is the latest incarnation of this venerable package, enhanced by built-in links to the Microsoft SQL Server, native SQL support, improved concurrency controls, and better applications development tools.

While the improvements over earlier versions are impressive, there are significant problems with Version 1.1's concurrency controls; it may no longer be the one to beat when it comes to multiuser applications.

There are two main differences between the Server Edition (\$1,295 for 3 users, \$7,995 for 20 users) and standard *dBASE IV* 1.1; the Server Edition has built-in support for accessing data on a SQL Server, and the base package supports three concurrent users. Individual database files are limited to 1 billion records, but since up to ten files can be open at once, the real limit is available disk space. Though there's no theoretical limit on the number of users, we discovered a significant degradation in performance after only a few test users were accessing a shared database.

User and data security are provided through the use of password protected log-in IDs, as well as access control levels that can protect down to the field level in a particular file. Dozens of utilities exist to browse .DBF files outside of *dBASE*, so additional data protection is provided by an optional ability to encrypt the database files. The combination of field-level access controls and data encryption makes *dBASE* one of the more

## Suitability to Task *dBASE IV, Server Edition*



secure packages we've reviewed.

Four levels of concurrency control are provided; two are automatic and the other two are exclusive. Opening a file or accessing a record in exclusive mode completely prevents other users from accessing the same file or record. Automatic locking of a file occurs when commands such as UPDATE, SORT, and APPEND FROM are executed. Individual records are locked when a user issues a command such as DELETE or REPLACE, and up to 50 records in a file can be locked at the same time. While automatic locking relieves the programmer of some of the effort in providing for data consistency, there are situations where an explicit lock on a record or file is the only way to ensure it.

Along with its built-in SQL, *dBASE IV*, Server Edition, provides a limited form

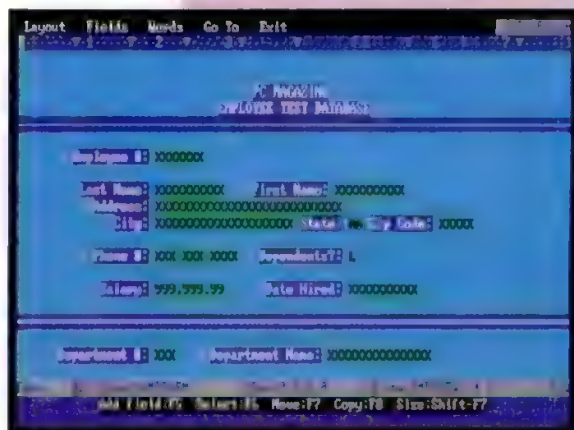
including an editor, a compiler, and a runtime system. Applications can be developed and run from the command line, or the programmer can use the User Interface Management System (UIMS).

These two approaches for creating databases and applications in *DataFlex*, however, reflect two different and conflicting programming methods. The traditional command line language is procedural, while the UIMS is more object-oriented; procedural programs must be converted before they can take advantage of the UIMS facilities.

Programmers new to *DataFlex* should use the UIMS as their primary programming environment with the understanding that its object-oriented paradigm may require a rethinking of their approach to creating database applications. The procedural language does include support for a number of graphing functions, so if there's a need to graph the data, the traditional method must be used. In either case, learning to program *DataFlex* can be a daunting task; the software comes with four hard cover manuals that average over 750 pages each.

In addition to the lack of built-in security, report creation is the weakest part of the system, since reports must be completely programmed—even the UIMS lacks a report generator. The optional *FlexQL* program provides a number of reporting capabilities at additional cost: \$295 for a single user and \$595 for eight users.

*DataFlex* is a complex system aimed primarily at applications developers that becomes even more complex by supporting two entirely different methods of programming. The lack of built-in security and the inability to import data from



The full-screen design interface of *dBASE IV*, Server Edition, eases the process of creating custom forms, reports, and mailing labels.



of transaction processing. Support is included to rollback changes made during a transaction that encountered problems; however, the transaction log isn't retained between successful runs, so there's no way to rollback a series of transactions to restore the database to its former state.

At first glance, the Server Edition appears to be a speed demon on some of PC Magazine Labs' performance tests, but the numbers, particularly those for transactions per second, are deceiving. The only way to get the timing data into the timing logs on the local hard disk was through the SET ALTERNATE ON function, which redirects screen data to the disk file. The program has a built-in 2K buffer that held the timing information in memory before writing it out; the other eight packages wrote data to disk after each run of the benchmark test module. We estimate that the TPS for multiple reads would have been about one half of the results we received, if *dBASE IV* had been able to write the timing log according to the test specification.

A more realistic picture of its multiuser performance can be gained from the tests that included reports, since a lock had to be placed on the entire file to perform them. *dBASE IV* turned in the worst time on the complex Report test and was significantly slower on the Mixed Workload tests when multiple writes were running on the other workstations, indicating that a lot of time was spent waiting for record locks to be released. Also noteworthy is the degradation in performance on the Random Writes tests; throughput peaked with only three active workstations, and dropped off noticeably when more than

six workstations were running.

*dBASE IV* can import data from a number of different formats, such as ASCII, PFS, .SDF, and .WK1, and the Server Edition provides the ability to query and manipulate data directly on a SQL Server using most of the standard *dBASE* commands. A source code-compatible version of *dBASE IV* is available for VMS systems, and various versions of Unix and a runtime module for the Macintosh are under development. The *dBASE Direct* series, which supports data access on IBM mini- and mainframe computers, are available for *dBASE III Plus* and *dBASE IV*.

#### LANGUAGE IMPROVEMENTS

*dBASE*'s strength has always been its procedural programming language, and there are a number of enhancements in the Server Edition that make it easier to create complex applications. Data validation has been enhanced, and a debugger with breakpoints has been added. Basic applications can be created through the Applications Generator, which can then be customized and optimized through User Defined Functions, programmer-defined menus, and the template language.

The query-by-example interface lets the programmer create and save queries and multitable views; these queries can be used in creating forms, reports, and mailing labels for use in applications. Full-screen drawing tools are available from the Control Center to assist in designing these items.

The *dBASE* language can be considered the standard for programming databases on the PC, which makes it appealing to those considering downsizing or integrating their large-system databases. However, the problems we found with *dBASE IV*'s multiuser performance make it a poor choice for large multiuser applications, and we can't recommend it over the other packages reviewed here. Developers who want to stick with the language should consider alternatives such as *FoxPro*, or they should wait to see what affect Borland's purchase of Ashton-Tate has on *dBASE*. (Borland was still developing dramatically different versions of *Paradox* and *dBASE* for Windows as this review was being prepared; for a preview of these two new products, see the sidebar "Still to Come from Borland: *Paradox* and *dBASE* for Windows.")

## FoxPro/LAN

**BY SAL RICCIARDI** The single-user version of *FoxPro*, Version 2.0, was a 1991 PC Magazine Technical Excellence Award winner. *FoxPro/LAN*, the multi-user version, brings the same capabilities to the network platform while adding support for concurrent access and multiple users. The product will appeal particularly to custom applications developers; its amazing engine speed and superb development environment make it an especially attractive development platform.

But *FoxPro/LAN* is not for the light-hearted user. Much of its functionality—especially in a multiuser setting—is available only through the issuance of commands, which you must remember, or the skills of a programmer.

The \$895 product gives you support for six users on a LAN. If you want to add users, you can purchase additional six-user license kits, which include a single copy of the documentation, for \$895. Additional documentation sets can be ordered for \$50 per set.

#### AUTOMATIC LOCKING

*FoxPro/LAN* supports concurrent use through traditional file and record locking. A file lock acquires exclusive write access to a file; other users have read access but cannot update, insert, or delete records. A record lock provides the same level of data access for a single record. Furthermore, it automatically locks files and records on an as-needed basis depending on the operation being attempted. For example, if you issue a command to replace a value in a range of records, *FoxPro/LAN* will automatically perform



### FACT FILE

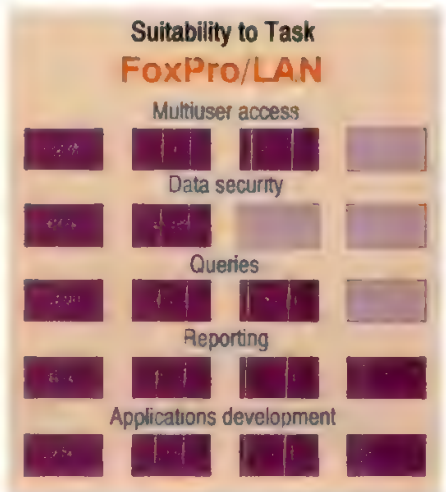
**dBASE IV, Version 1.1, Server Edition**  
Borland International Inc., P.O. Box 660001,  
1800 Green Hills Rd., Scotts Valley, CA  
95067; 408-438-8400.

**List Price:** 3 users, \$1,295; 20 users, \$7,995.

**Requires:** 640K RAM, hard disk, DOS 3.1 or later, DOS 3.1-compatible network operating system.

**In Short:** Although the *dBASE* language can be considered the standard for PC database development, the Server Edition of *dBASE IV* has performance problems that make it a poor choice for large multiuser database projects.

CIRCLE 402 ON READER SERVICE CARD





a file lock and then release it when the command finishes. During interactive use, such as with the Browse and Edit commands, as soon as you begin to change a record by typing into a field *FoxPro/LAN* locks it. When you are finished making your changes and move the cursor off the record, *FoxPro/LAN* releases the lock. You can also explicitly lock the record by pressing the Ctrl-O key.

In addition to implicit locking, you can explicitly lock files and records using the

**FLOCK()** and **RLOCK()** functions, respectively. Both functions return a logical true or false value indicating whether or not the lock attempt was successful. You can lock more than one record by supplying the record numbers all at once to the **RLOCK()** function, provided you have previously **SET MULTLOCKS ON**. One oddity with *FoxPro/LAN*'s record locking is that you cannot release record locks

individually. Instead, the **UNLOCK** command automatically releases all file and record locks in the current work area.

Deadlocks are prevented by means of the **SET REPROCESS** command, which determines how unsuccessful lock attempts are handled. By default, if a lock attempt is made for a resource that is unavailable, *FoxPro/LAN* will display the system message "Attempting to lock... Press Esc to Cancel" and retry the lock indefinitely. In this manner, deadlock is

## STILL TO COME FROM BORLAND: Paradox and dBASE for Windows

by Sal Ricciardi

As we went to press, Borland International had new versions of its two database systems in the works that should put to rest any lingering doubts about the company's ability to support *dBASE* and *Paradox*. The Microsoft Windows versions of both products will add new features to each program, while providing links to each other through Windows and through Borland's Database Engine.

*Paradox for Windows* will bring *Paradox*'s easy-to-understand, table-oriented metaphor to the Windows environment, with a strong emphasis on objects and object-oriented methodology. In *Paradox for Windows*, every component is an object, from queries to forms to the grid lines on a table.

Objects have properties and methods. *Properties* are values that represent characteristics such as color, size, and location. *Methods* are code snippets that determine an object's behavior. For example, when a mouse is clicked on an object, a method gains control and determines how the object reacts to that mouse click. Each object has a number of predefined methods written in ObjectPAL, the *Paradox for Windows* programming language. You'll be able to modify existing methods or add new ones.

*Paradox for Windows* will be file format-independent in that it will be able to read and write *Paradox* tables, *dBASE* databases, and other file formats through the Borland Database

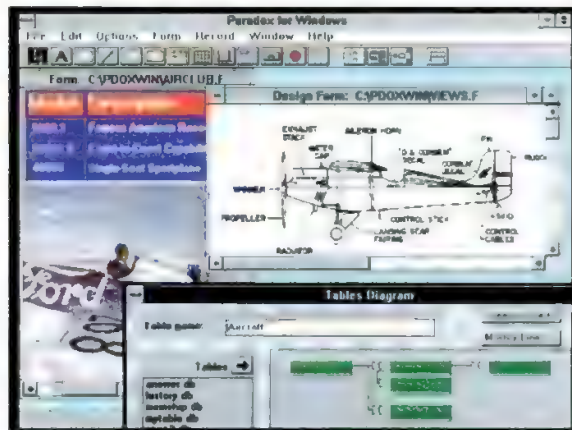
Engine. The new forms and report designers are object-oriented as well, and can include graphics and OLE (object linking and embedding). You'll be able to use the forms designer to

have much the same look and feel as *Paradox for Windows*, while providing support for the *dBASE* language. In fact, both products will share many of the same design tools. For program development, the new product will use an integrated development environment based on the one that is included with Borland C++. And the product will include a fast compiler capable of producing standalone executable files.

The language is fully *dBASE IV*-compatible, with a number of enhancements and extensions. One welcome change is that there is no more SQL mode switch. You will be able to include in your *dBASE* code **SELECT** statements that are executed and optimized by the Borland Database Engine. The product will also support a tightly integrated QBE.

You'll be able to use Windows controls in your screen designs through extensions to the @..SAY and @..GET commands. Fortunately, the syntax for these extensions is much like English. For example, a radio button is called a **RADIOBUTTON**. You can bind methods to objects in a manner similar to *Paradox for Windows*, except that the code, of course, is *dBASE*.

Other enhancements include support for calling standard C functions in DLLs, static and local variables, a language preprocessor, and DDE and OLE support. Borland also intends to support the creation of DOS *dBASE* executable files. ■



*Paradox for Windows* will let you create links between tables visually. A complete set of feature-rich design tools lets users create impressive forms and reports.

build attractive screens that include full support for Windows controls. And, of course, *Paradox for Windows* will include an implementation of query by example that is similar to the DOS version.

The database engine will include the query engine now in *Paradox for DOS*, making advanced query support available to any application accessing the engine. Additionally, integrity maintenance will be part of the engine's repertoire. This means referential integrity support will exist at the table level instead of the forms level in *Paradox*.

Borland's *dBASE for Windows* will



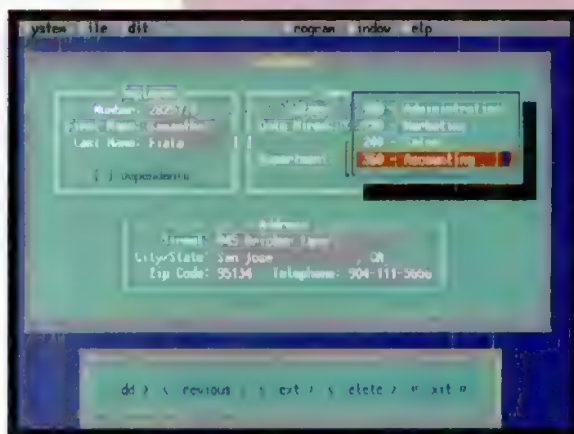
avoided, since you can cancel the lock attempt at any time. You can change the default behavior so that *FoxPro/LAN* automatically retries the lock attempt a fixed number of times before giving up, or so that it retries continuously for a specific amount of time before giving up. If a lock cannot be obtained, a suitable message is displayed.

When shared databases in a network are being updated by multiple users, your local view of a database may become outdated. *FoxPro/LAN*'s refresh mechanism will automatically refresh records displayed on your screen to reflect changes made by other users, if you are using either the interactive Browse, Edit, Modify Memo, or Change commands. You can specify how often *FoxPro/LAN* does the refresh by issuing the SET REFRESH TO command with a number in seconds.

#### INTEGRITY BY PROGRAMMING ALONE

*FoxPro/LAN*'s database engine has no built-in support for enforcing referential integrity. All integrity controls require programming. Similarly, *FoxPro/LAN* does not provide any built-in support for data security. In a network environment you will have to program your own security measures or rely on those provided by your network operating system for restricting access to directories and files.

Query support is strong. The Rushmore



*FoxPro/LAN* lets you create attractive screens that use pull-down menus, push buttons, scrollable text edit regions, pop-up menus, list boxes, and so forth.

## CLARION 3.0 SHOULD GAIN SPEED WITH OPTIMIZING COMPILER

by Gus Venditto

As the nine products in this review were being tested at PC Magazine Labs, Clarion Software was in the final stages of preparing its next major upgrade—a revision so dramatic that it would have been misleading to include the current shipping version in this roundup.

*Clarion Professional Developer*, Version 3.0, promises a significant improvement in the execution speed of Clarion applications, thanks to a replacement of the program's compiler with *TopSpeed*, an optimizing code generator from Jensen and Partners. Clarion Software says that CPU-intensive operations should run several hundred times faster as a result of the new compiler.

Additionally, because *TopSpeed* will create true object code, it will be possible to link Clarion application object code with modules from other languages. Other benefits of the new compiler will be the creation of smaller executable files and incremental linking/debugging.

Version 3.0 will also eliminate overlays from the Clarion development environment; instead, *TopSpeed* will provide DLLs (dynamic link libraries) that will make it possible to fit larger programs in 640K. The DLLs will be

stored on-disk or in RAM (conventional, extended, or expanded) if available.

Clarion says it will also provide drivers for accessing other databases. The initial shipment of Version 3.0 will include drivers for Btrieve, Ctree, dBASE, and NetWare SQL. In the future, drivers for Gupta SQL, Oracle, Paradox, Sybase, SQL Server, and Sybase should be posted on Clarion Software's on-line service (you must be registered in the Clarion Developer's Exchange to gain access; a \$150 annual membership fee is required). The company promised that it will publish the specifications for database drivers to help those who want to add their own drivers.

Among the other enhancements in *Professional Developer 3.0* is the ability to display and resize graphics images from any screen, including a feature that will automatically switch a text mode screen to graphics mode when a graphics image is opened. And a new database dictionary will make it possible to define data files globally, providing referential integrity and transaction integrity. *Professional Developer 3.0* will cost \$995 (Clarion Software, Pompano Beach, FL; 800-354-5444 or 305-785-4555). ■

data access technique combined with Fox Software's adaptive query optimizer produce fast results and help minimize traffic on a LAN by intelligently using indexes. The new relational query by example (RQBE) provides a dialog-driven method of generating queries, but is not as intuitive or as friendly as traditional fill-in-the-blank style QBE. Both RQBE and SQL SELECT can send their output to a cursor, which can then be used for producing reports.

*FoxPro/LAN*'s report writer makes designing reports a pleasure. It is object-oriented, which makes it easy to experiment and move things around on the design surface. You can include fields from multiple tables and can use the preview mode to see what your design looks like. By default, *FoxPro/LAN* does not issue any automatic locks for read-only operations such as producing a report, calculating an average, and so on. To obtain a consistent result you must lock each one of the databases involved. You can change *FoxPro/LAN*'s default behavior to perform the file lock automatically for certain read-only commands by issuing SET LOCKS ON.

The product provides an impressive array of developers' tools. The project manager (PM) is a sort of home base for development work. With the project tool, you can group together all of the files, programs, screens, and reports needed to create an application. Then, when you want to make sure the project is up to date, you tell the PM, and it will refresh only



# APPLICATIONS DEVELOPMENT MULTIUSER DATABASES



## SUMMARY OF FEATURES

Products listed in alphabetical order

☒ Yes ☐ No

|                                      | Advanced<br>Revelation              | DataEase                            | DataFlex                            | dBASE IV,<br>Server Edition         | FoxPro/LAN                          | KnowledgeMan                        | Paradox                             |
|--------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Version                              | 2.11                                | 4.2                                 | 3.0                                 | 1.1                                 | 2.0                                 | 3.0                                 | 3.5                                 |
| <b>HARDWARE CONSIDERATIONS</b>       |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Expanded memory support              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Disk cache included                  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Mouse support                        | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Disk space required (kilobytes)      | 7,168                               | 1,347                               | 5,280                               | 4,448                               | 6,144                               | 1,984                               | 2,377                               |
| <b>DATA LIMITS</b>                   |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Maximum column or field size (bytes) | 65,530                              | 255                                 | 16,384                              | 254                                 | 254                                 | 65,534                              | 255                                 |
| Maximum row or record size           | 65,530                              | 4,000                               | 16,384                              | 4,000                               | 4,000                               | 65,534                              | 4,000                               |
| Maximum number of:                   |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Fields per record                    | 65,530                              | 255                                 | 255                                 | 255                                 | 255                                 | 255                                 | 255                                 |
| Records per table or file            | Unlimited                           | 16 million                          | 16.7 million                        | 1 billion                           | 1 billion                           | 2 billion                           | 2 billion                           |
| Indexes per database                 | Unlimited                           | 508,000                             | 3,750                               | 47                                  | Unlimited                           | Unlimited                           | 255                                 |
| Open files or tables                 | Unlimited                           | 60                                  | 250                                 | 99                                  | 25                                  | Unlimited                           | 24                                  |
| <b>DATA TYPES</b>                    |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Arrays:                              |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Dimensioned                          | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Variable-length                      | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Fixed-character                      | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Variable-character                   | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Integer                              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Fixed-decimal                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Floating-point                       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Date                                 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Time                                 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |
| Boolean                              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Virtual (calculated)                 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| <b>FILING SYSTEM</b>                 |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Proprietary                          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| dBASE III-compatible                 | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| dBASE IV-compatible                  | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| <b>INDEXING</b>                      |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Automatic indexing                   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Composite-field indexing             | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Optional-key indexing                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Definable exclusion list             | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| <b>DATA DEFINITION</b>               |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Data dictionary                      | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| File catalog                         | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| <b>DATA VALIDATION</b>               |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Data-type enforcement                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Specific match                       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Pattern match                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Data ranges                          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Table lookups                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| User-definable                       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Rule-based                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Soundex                              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| <b>QUERY LANGUAGE</b>                |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Proprietary                          | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| ANSI SQL                             | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| dBASE-compatible                     | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| DB2 SQL                              | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |
| ISO SQL                              | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |

## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES

### KnowledgeMan

those files that have changed. The *FoxPro/LAN* Distribution Kit (\$500) can be used with the PM to create applications for distribution.

The object-oriented screen builder lets you draw your data entry screens and have *FoxPro/LAN* generate the appropriate code. You can use the mouse to place fields, text, lines, and boxes and use any of *FoxPro/LAN*'s new controls in a design window while attaching code snippets to the objects. The Menu Builder works in a similar fashion, letting you design, test, and generate code for menus.

An external API provides access to much of *FoxPro/LAN*'s internals. Using either C or assembler and the \$500 API Library Construction Kit, you can create add-on libraries of routines that can be accessed from *FoxPro/LAN*. One library, included with *FoxPro/LAN*, provides an interface to *NetWare*'s Transaction Tracking System. You can use it to build transaction definitions and to commit and rollback features into your applications. While *FoxPro/LAN* does not itself include links or hooks to outside database servers, it seems likely that third-party products will address this using the API library interface, perhaps even by the time you read this.

In the final analysis, *FoxPro/LAN*'s weaknesses include complexity for end users, rigid record locking, and the lack of internal support for integrity controls and data security. The product's industry-leading speed in single-user applications doesn't hold up on a busy network. But the product's amazing speed and rich development environment make it an attractive choice for applications on small networks or where contention for records is light.



#### FACT FILE

##### *FoxPro/LAN*, Version 2.0

Fox Software Inc., 134 W. South Boundary, Perrysburg, OH 43551; 800-837-3692, 419-874-0162.

**List Price:** \$995, distribution kit, \$500, API library construction kit, \$500; extra documentation sets, \$50.

**Requires:** 512K RAM, DOS 3.1 or later, DOS 3.1-compatible network operating system.

**In Short:** *FoxPro/LAN* is a solid performer with a superb environment for developing database applications. But it offers no data security for your network.

**BY JOE SALEMI** If you're looking for a multiuser database development system with strong security features, a powerful development language, and applications compatibility across various platforms, *KnowledgeMan*, Version 3.0, from Micro Data Base Systems (MDBS), may be your answer. Its interface is simple enough for end users, yet has enough development capabilities to assist both novice and experienced programmers in designing applications. Like *DataFlex*, it is primarily a programmer's environment; many capabilities that are built into other PC-based database systems have to be custom programmed in this one.

*KnowledgeMan* is available as a \$995 single-user version or for \$2,495 per server. It runs on all versions of *NetWare*, *LAN Manager*, IBM's *PCLAN*, and other DOS-based file-locking operating systems. Versions are also available for OS/2, VMS, and Unix environments; it should prove easy to move applications written under one version to another.

Network traffic and database size are the only limits on the number of simultaneous users. Individual tables can hold up to 2 billion records, and a database can consist of up to 240 tables, making disk space the only real limit on database size.

#### EXCLUSIVE AND SHARED ACCESS

While it has no built-in transaction processing, *KnowledgeMan* provides excellent concurrency controls through two levels of access—exclusive and shared. Exclusive access locks the entire table and is primarily used for commands that modify the database itself, such as packing the file to remove deleted records, or creating new indexes. Shared access provides locks on a single record or a group of records, and *KnowledgeMan* will automatically attempt to lock the appropriate records when certain commands are executed.

**HOLD** and **DROP** functions are also available for explicit locking in an application. But there is no retry function to resolve deadlocks; the applications programmer must provide for the proper handling error codes returned when a deadlock occurs.

When the optional user security is active, *KnowledgeMan* provides 16 read-access and 16 write-access codes that can

CONTINUES

CIRCLE 493 ON READER SERVICE CARD



## SUMMARY OF FEATURES

Products listed in alphabetical order

☒—Yes    ☐—No

|                                            | Advanced<br>Revelation              | DataEase                            | DataFlex                            | dBASE IV,<br>Server Edition         | FoxPro/LAN                          | KnowledgeMan                        | Paradox                             |
|--------------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| <b>QUERY INTERFACE</b>                     |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Command line                               | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Menu-driven                                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Query by form                              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Query by example                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| <b>DATABASE LANGUAGE FEATURES</b>          |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Compiled                                   | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Interpreted                                | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Embedded SQL queries                       | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| <b>MACRO CAPABILITIES</b>                  |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Automatic recording                        | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Keystroke memory                           | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Macro language                             | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| <b>SECURITY</b>                            |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Data encryption                            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Application encryption                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Password protection:                       |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| User                                       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Database                                   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Dictionary                                 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Table                                      | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Record                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Field                                      | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| <b>RESTRICTED ACCESS LEVELS</b>            |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| User                                       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Database                                   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Dictionary                                 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Table                                      | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Record                                     | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |
| Field                                      | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| <b>LOCKING</b>                             |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Coordinated                                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Exclusive                                  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Shared                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Promotable                                 | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Database                                   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| File                                       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Record                                     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Field                                      | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            |
| <b>TRANSACTION PROCESSING</b>              |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| Transaction definition                     | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| Supports commit and rollback transactions  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| Two-phase commit                           | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| Implicit locking                           | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Isolation control                          | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            |
| <b>NETWORK OPERATING SYSTEMS SUPPORTED</b> |                                     |                                     |                                     |                                     |                                     |                                     |                                     |
| LAN Manager                                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| NetWare                                    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Unix                                       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| VINES                                      | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |





## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES



### FACT FILE

#### KnowledgeMan, Version 3.0

Micro Data Base Systems Inc., P.O. Box 6089, Lafayette, IN 47903; 317-447-1122.

**List Price:** Single user, \$995; for each server, \$2,495.

**Requires:** 640K RAM, 5MB hard disk space, DOS 3.1 or later.

**In Short:** This is a complete database developers' package, with strong security and excellent concurrency control for multiuser systems. *KnowledgeMan's* application-level compatibility with non-DOS versions is a definite plus.

CIRCLE 495 ON READER SERVICE CARD

gram (available separately). Full debugging capabilities are provided, with support for single-step execution, breakpoints, and watch variables.

One interesting feature for applications developers is *KnowledgeMan's* support for User Defined Functions (UDFs). A programmer can create a UDF using a subset of KGL to provide capabilities such as data verification; the UDF can then be compiled to become part of the developer's KGL environment.

Also new to *KnowledgeMan 3.0* is support for the Binary Large Object (BLOB) data type. A *BLOB* is an external text or graphics file that is displayed on the screen when the record it is associated

with is queried. This capability is similar to the graphics display in *Superbase 4*, with the distinction that it works in character mode instead of requiring Microsoft Windows 3.0.

While its end-user querying functions aren't as sophisticated as some of the other databases that are reviewed here, applications developers will find *KnowledgeMan* to be a complete and powerful database programming system, with strong security, good performance, and excellent multiuser support. Its applications compatibility across multiple platforms makes it worthy of consideration by those who are looking to downsize from a mainframe application or to integrate their company's existing databases.

### SUMMARY OF FEATURES

Products listed in alphabetical order

☒—Yes ☐—No

|                                       | Advanced Revelation                          | DataEase                                           | DataFlex                            | dBASE IV, Server Edition                                                   | FoxPro/LAN                          | KnowledgeMan                              | Paradox                                          |
|---------------------------------------|----------------------------------------------|----------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------|-------------------------------------|-------------------------------------------|--------------------------------------------------|
| <b>GATEWAYS</b>                       |                                              |                                                    |                                     |                                                                            |                                     |                                           |                                                  |
| db2                                   | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                        | <input type="checkbox"/>            | <input type="checkbox"/>                  | <input checked="" type="checkbox"/>              |
| Microsoft SQL Server                  | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                        | <input type="checkbox"/>            | <input checked="" type="checkbox"/>       | <input checked="" type="checkbox"/>              |
| Oracle                                | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input type="checkbox"/>            | <input checked="" type="checkbox"/>                                        | <input type="checkbox"/>            | <input type="checkbox"/>                  | <input checked="" type="checkbox"/>              |
| Other                                 | None                                         | None                                               | None                                | Focus; IBM AS/400, System/36, System/38; IDMS; IMS; Sybase SQL Server; TSO | None                                | None                                      | IBM OS/2 EE DBMS, Sybase SQL Server, VAX Rdb/VMS |
| <b>APPLICATIONS DEVELOPMENT TOOLS</b> |                                              |                                                    |                                     |                                                                            |                                     |                                           |                                                  |
| Applications generator                | <input type="checkbox"/>                     | <input type="checkbox"/>                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input type="checkbox"/>                  | <input checked="" type="checkbox"/>              |
| Menu generator                        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/>                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input type="checkbox"/>                  | <input checked="" type="checkbox"/>              |
| Program editor                        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/>                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input checked="" type="checkbox"/>              |
| Report generator:                     |                                              |                                                    |                                     |                                                                            |                                     |                                           |                                                  |
| Form-based and line-based reports     | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/>                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input checked="" type="checkbox"/>              |
| Maximum number of report variables    | Unlimited                                    | 254                                                | Unlimited                           | 15,000                                                                     | Unlimited                           | Unlimited                                 | 255                                              |
| Runtime version                       | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input checked="" type="checkbox"/>              |
| <b>DEBUGGING FUNCTIONS</b>            |                                              |                                                    |                                     |                                                                            |                                     |                                           |                                                  |
| Single-step execution                 | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input checked="" type="checkbox"/>              |
| Breakpoints                           | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input checked="" type="checkbox"/>              |
| Watchpoints                           | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input checked="" type="checkbox"/> | <input type="checkbox"/>                                                   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input type="checkbox"/>                         |
| Error handling                        | <input checked="" type="checkbox"/>          | <input checked="" type="checkbox"/>                | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>                                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input checked="" type="checkbox"/>              |
| <b>LINK LIBRARIES/LANGUAGES</b>       |                                              |                                                    |                                     |                                                                            |                                     |                                           |                                                  |
| Assembler                             | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input type="checkbox"/>            | <input type="checkbox"/>                                                   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input type="checkbox"/>                         |
| BASIC                                 | <input type="checkbox"/>                     | <input type="checkbox"/>                           | <input type="checkbox"/>            | <input type="checkbox"/>                                                   | <input type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         |
| C                                     | <input checked="" type="checkbox"/>          | <input type="checkbox"/>                           | <input checked="" type="checkbox"/> | <input type="checkbox"/>                                                   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/>       | <input type="checkbox"/>                         |
| Pascal                                | <input type="checkbox"/>                     | <input type="checkbox"/>                           | <input type="checkbox"/>            | <input type="checkbox"/>                                                   | <input type="checkbox"/>            | <input type="checkbox"/>                  | <input type="checkbox"/>                         |
| <b>TECHNICAL SUPPORT</b>              |                                              |                                                    |                                     |                                                                            |                                     |                                           |                                                  |
| Basic phone support                   | Free (3 months)                              | Free (6 months)                                    | Free (unlimited)                    | Free (30 days)                                                             | Free (unlimited)                    | None                                      | Free (unlimited)                                 |
| Extended phone support                | \$400 per year (unlimited access to hotline) | Via 900 number (\$2/minute), or by annual contract | \$95 for 6 calls                    | \$295 (12 calls), \$595 (30 calls)                                         | Same as above                       | \$450 per year (single user); \$825 (LAN) | Same as above                                    |
| Developer support                     | \$2,000–\$5,000 per year                     | \$200–\$2,000 per year                             | Same as above                       | \$1,595 (unlimited)                                                        | Same as above                       | Same as above                             | \$295.00 for 1 year, then \$139.95 per year      |

## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES

### Paradox

**BY SAL RICCIARDI** *Paradox 3.5's* primary strengths include its easy-to-understand table metaphor and its excellent implementation of query by example (QBE), which makes getting to the data you want a simple matter of filling in the blanks and pressing the execution key. Multiuser *Paradox* is just like single-user *Paradox* from an end-user standpoint. Where differences exist, they're handled implicitly and are pretty much transparent.

The \$795 standalone package supports one user locally or on a network. To add users, you can purchase *Paradox* LAN Packs, which come in two flavors: A

single-user LAN Pack costs \$295 and includes the end-user portion of the documentation set and a ten-user LAN Pack costs \$2,495 and includes one copy of the end-user portion of the documentation set. You can purchase additional end-user documentation sets for \$40 each.

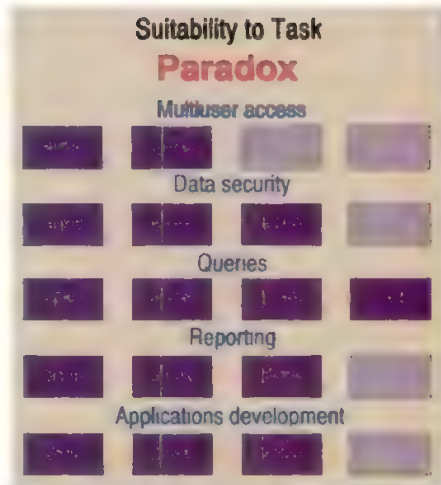
#### FOUR TYPES OF TABLE LOCKS

To implement concurrency, *Paradox* includes a lock manager that supports locking at the table and record levels. Four types of table locks are supported: Full Lock, Write Lock, Prevent Full Lock, and Prevent Write Lock.

A Full Lock gives you complete read and write access to a table while preventing other users from accessing it at all. This is the most restrictive type of lock, since other users are prevented from even reading the table. Write Locks prevent other users from changing the contents of a table while still allowing read access. A Prevent Full Lock prevents other users from placing a Full Lock on a table, while a Prevent Write Lock prevents other users from placing either a Full Lock or a Write Lock on a table. In effect, a Prevent Write Lock guarantees that other users will not prevent you from gaining access to and modifying a table.

The last two prevent lock types are really restrictions on whether or not you can place the first two. A Prevent Full Lock prevents read access from being denied by the *Paradox* lock manager. And a lock at the record level provides exclusive write access to a single record; other users can read the record but cannot modify or delete it. Record locks are used during a special editing mode called CoEdit, which allows multiple users simultaneous read and write access to a table. When you are co-editing and begin to change a record, *Paradox* automatically locks it. Then, when you finish editing and move the cursor to another record, your changes are automatically posted to the table and the record lock is removed.

When working with tables on a network, your image of a table can become outdated due to changes made to that table



by other users. *Paradox* supports both automatic and explicit refreshing of images. Using the AutoRefresh menu selection, you can set the refresh interval from 1 second to 1 hour, or disable AutoRefresh entirely.

#### REFERENTIAL INTEGRITY

*Paradox* provides limited support for referential integrity through linked multi-table forms. Since this support exists only at the forms level and not at the database level, it can easily be defeated. Of course, custom applications written in PAL can provide additional integrity checks and can insist that all updates be made through the same multitable forms. If this technique is used in a custom application, *Paradox* will not allow a master record to be deleted if detail records exist, and will automatically cascade changes to a master key.

Query support is especially strong. The heuristic query optimizer produces fast



With *Paradox's* interactive query by example, formulating ad hoc queries on multiple tables is a breeze.

| R:BASE                                                            | Superbase 4                                                    |
|-------------------------------------------------------------------|----------------------------------------------------------------|
| <input type="checkbox"/>                                          | <input checked="" type="checkbox"/>                            |
| <input type="checkbox"/>                                          | <input checked="" type="checkbox"/>                            |
| <input checked="" type="checkbox"/>                               | <input checked="" type="checkbox"/>                            |
| Ingres, RDB                                                       | SQLBase Server, Sybase SQL Server, XDB                         |
| <input checked="" type="checkbox"/>                               | <input type="checkbox"/>                                       |
| <input checked="" type="checkbox"/>                               | <input checked="" type="checkbox"/>                            |
| <input checked="" type="checkbox"/>                               | <input checked="" type="checkbox"/>                            |
| <input checked="" type="checkbox"/>                               | <input checked="" type="checkbox"/>                            |
| 100                                                               | Unlimited                                                      |
| <input checked="" type="checkbox"/>                               | <input checked="" type="checkbox"/>                            |
| <input type="checkbox"/>                                          | <input checked="" type="checkbox"/>                            |
| <input checked="" type="checkbox"/>                               | <input type="checkbox"/>                                       |
| <input checked="" type="checkbox"/>                               | <input type="checkbox"/>                                       |
| <input checked="" type="checkbox"/>                               | <input type="checkbox"/>                                       |
| <input checked="" type="checkbox"/>                               | <input type="checkbox"/>                                       |
| Free (unlimited)                                                  | Free (90 days)                                                 |
| 800 number (\$99/year); 900 number (\$2/minute); \$149 (10 calls) | \$299 per year (premier service); \$1,500 per year (corporate) |
| None                                                              | Same as above                                                  |

ENDS



results, and QBE makes formulating a query a breeze. In a network environment, *Paradox* attempts to ensure data consistency during a query or report operation. This feature, known as query restart, automatically restarts the query if changes are detected that would affect the results. In a busy network environment, this can cause a query to restart almost indefinitely. But you can anticipate this by specifying the number of times that *Paradox* should restart the query before giving up. One alternative, which Borland International

used on the PC Magazine Labs' performance tests, is to place a Write Lock on the tables involved prior to issuing the query. This, of course, prevents other users from making updates for the duration of the query.

Heavy network traffic can cause queries to slow down significantly, though. *Paradox* always writes the results of a query to disk in a temporary table, regardless of the output mode. This feature works

well for a single user but it can be a significant drag on the network's performance. Borland recommends configuring the system so that temporary tables are written to a local hard disk.

The PAL language includes a number of commands and functions for building multiuser applications. For example, the PAL Lock, Unlock, LockRecord, and UnlockRecord commands explicitly lock and unlock tables and records, respectively. Developers can distribute applications by purchasing the \$49 *Paradox*

## OTHER MULTIUSER DATABASES TO CONSIDER

by Camille N. Cline

In this roundup, we review nine of the leading multiuser databases that function as both standalone and network systems. They are all based on the file-server paradigm.

In addition to the programs included in this review, we looked at ten other multiuser database products that met our criteria. But due to editorial space constraints and the resources involved in managing a 24-node test network per product, we chose to focus on the nine products that compete most directly with each other.

Other multiuser databases are designed specifically for client-server applications. We will be reviewing these—which include offerings from Oracle and Gupta—in an upcoming issue this year. What follows is a summary of features for the multiuser-standalone products not included in the formal testing procedures.

*Alpha Four*, Version 2.0, has a powerful scripting language that can record keystrokes or build a full-screen application. The current version added support for Novell and NetBIOS networks. Prices range from \$495 to \$1,249 for a 5-user network pack. (Alpha Software, Burlington, Mass.; 617-229-2924.)

*D the Data Language* is a fourth-generation language (4GL), treating files, screens, menus, and reports as objects. As a relational database, *D* maintains an unlimited number of files, records, and keys. It also provides an environment for math, financial, and statistical functions. The product sells for \$1,295 for a five-user DOS-based

LAN, and \$1,995 for Unix- and Xenix-based LANs. It supports a number of other platforms, including AIX, LANtastic, NetWare, and 3Com's network operating systems. (DCaltex Software Inc., Dallas, Texas; 214-522-9840.)

*filePro Plus*, Version 4.0, is a 4GL and relational database management system (RDBMS) that runs as a menu-driven application generator. Its Screen and Report Painter, custom Menu Generator, built-in debugger, and event-driven processing allow the end user to create comprehensive data files; it also offers password protection and record-locking for extensive security. AIX, MS-DOS, Unix, VMS, and Xenix are among the 12 network operating systems that *filePro Plus* supports. It carries a list price of \$1,495 for one to five users, and \$100 for each additional user. (The Small Computer Company Inc., Hawthorne, New York; 914-769-3160.)

*Informix-OnLine*, Version 4.1, is a second-generation language, which primarily runs on Unix-based network operating systems and costs \$225,000 for multiple users. The on-line transaction processing (OLTP) database engine provides quick and constant data flow. According to the manufacturers, *Informix-OnLine* can store unstructured objects, or binary large objects (BLOBs), with the same level of performance as any fixed field in the database. Informix also supplies shared access multiple log buffers, sorted Writes, and multiple "page cleaners," which write all of the modified pages from shared memory to the disk. (Informix Software Inc., Menlo Park,

California; 415-926-6300.)

*NPL/R*, another 4GL, is packaged for an unlimited number of users at \$795 (*NPL* stands for *nonprocedural language*). It combines an interactive interpreter, compiler object code, and structured query language (SQL). *NPL/R*'s strength, according to its creators, is that it requires fewer lines of code than its competitors. It also provides a menu interface, on-screen windows, statistical procedures, and relationality. (Database Applications Inc., Princeton, New Jersey; 609-924-2900.)

*Open Access III*, Version 3.02, a network-ready integrated program for up to four users, includes database management, word processing, spreadsheets, graphics, electronic mail, appointment scheduling, and telecommunications. You can integrate C language functions and use query by example (QBE) or SQL. *OA Vision*, the add-in graphics image manager, provides storage and printing capabilities of photographic-quality images with VGA and EGA monitors. *Open Access III* costs \$4,995 for an unlimited network and eight sets of documentation. Single users may be added for \$245, which includes documentation. Five users may be added for \$695, with one set of documentation. (Software Products International Inc., San Diego, California; 800-937-4774, 619-450-1526.)

*pcExpress*, Version 3.0, another 4GL, features a full set of tools for the end user, including graphics, reporting, forecasting, modeling, and analytic functions, such as aggregation,

CONTINUES



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COMPUADD 320sc  
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**REDUCED \$400**  
COMPUADD 333  
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Advanced 80386DX design in a low-profile system ■ Local video for enhanced video performance ■ 4MB DRAM expandable to 32MB ■ 80MB hard drive ■ Cache memory controller with 64KB SRAM ■ a hot slot for HardCache/ESDI OR Hi-Rez cards

**REDUCED \$300**  
COMPUADD 425  
**\$2295\***

Our 425 is more than 30% faster than the 386-powered system running at the same clock speed ■ 80486SX microprocessor rated at 25MHz ■ 8KB cache, floating point processor, ROM-based setup ■ Stretch chassis with more drive upgrade options

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40MB TO 80MB ..... ADD \$200  
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expandable to 16MB ■ 40MB hard drive ■  
Cache memory controller with 32KB SRAM  
■ One year free onsite service

**REDUCED \$300**  
COMPUADD 420s  
**\$1895\***

486 generation technology in a full profile machine ■ 80486SX microprocessor rated at 20MHz ■ 40MB hard drive ■ 4MB DRAM expandable to 64MB ■ Hot slot for Hi-Rez card ■ 64KB cache with 256KB cache option  
■ One year free onsite service

**REDUCED \$500**  
COMPUADD 433ISA  
**\$2295\***

The expandability of a full-profile machine with 33MHz speed ■ 80MB hard drive ■ 80486DX-powered ■ 4MB DRAM expandable to 64MB ■ Hot slot for Hi-Rez card ■ 64KB cache with option for 256KB cache ■ One year of free onsite service

#### **HARD DRIVE & VIDEO UPGRADE OPTIONS**

40MB TO 80MB ..... ADD \$200  
80MB TO 120MB ..... ADD \$100  
120MB TO 200MB ..... ADD \$300  
MGA TO HI-REZ COLOR VGA ... ADD \$300  
(1024 x 768)

**ALL SYSTEMS INCLUDE  
MS-DOS 5.0 & WINDOWS 3.0**

\* Price includes monochrome monitor with each system.

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runtime. This, in effect, purchases an unlimited license for a custom multiuser application. Users do not need to purchase LAN packs to run the application.

Data security is enforced through owner and auxiliary passwords and through an array of access levels that let you restrict table access down to the field level. Developers can use the Paradox Protection Generator to set up a protection system for their applications. This is more than a valuable time-saver; it's a good way to learn *Paradox's* security system.

#### PERFORMANCE

*Paradox* turned in mixed results on the performance tests. It builds a clustered index that sorts data physically; this takes longer to build and inhibits loading performance, but it results in very fast retrievals after the index is complete. It also writes the results of queries to disk automatically, which can inhibit performance on a busy network.

*Paradox SQL Link*, a separate \$495

#### CONTINUED

time series, and sorting. It also boasts a multidimensional view of data files for easier access, integration, and manipulation. MPE/XL, MVS, OS/2, Unix, VM, and VMS are among the platforms upon which *pcExpress* can run. Version 3.0 offers an entire spectrum of pricing options, covering 64MB, 256MB, and 512MB and higher for 2 to 5, 6 to 10, 11 to 15 and more users, and ranging from \$10,000 to \$50,000 for LANs. (Information Resources Inc., Waltham, Massachusetts; 617-890-1100.)

*Q-PRO 4*, \$350, is designed specifically for professional applications developers. It offers event-driven architecture, "painted" screens, multiple data entry windows, dialog boxes, menus and a nonprocedural report generator. Its application environment maintains over 115 commands. *Q-PRO 4* also offers the optional Author's LockUp, \$350, an application distribution system for developers. Author's LockUp tokenizes, encrypts, and locks application programs. (QNE International, Langhorne, Pennsylvania; 215-968-5966.)

*Sterling ZIM*, Version 4.0, is a 4GL/RDBMS. It runs on the leading network operating systems, MS-DOS, OS/2, QNX, Unix, and VAX/VMS. *ZIM 4.0* costs \$3,165 for one to four users under the developers' package, and \$2,640 for the same number under the basic package. It features a Development Center and Screen Painter. The language fully integrates SQL for developers and offers complete application code portability. Sterling ex-

pects to release three ZIM client-server versions in the first quarter of 1992 for Oracle RDBMS, Microsoft's SQL Server, and IBM's DB2. (Sterling Software International, Ottawa, Ontario, Canada; 613-727-1397.)

*Team-Up 2.2's* network package is a ten-workstation license that sells for \$1,990. *Team-Up* allows the end user to import data by running databases without slowing down network response time. Because indexes are created as the data is imported, records are quickly made available to network users. *Team-Up* offers importation of partial records or fields, and the import format need not match that of the database. Ten levels of security may support up to 32 user levels at the function, file, record, and field. *Team-Up*, Version 3.0 for Windows, Unix, and DOS, is scheduled for release in the second or third quarter of 1992. (Unlimited Processing Inc., Jacksonville, Florida; 800-874-8555, 904-731-8330.)

*VP-Info Professional* has a built-in compiler and complete network support. It offers data loading without overlays to provide fast querying and retrieval of data files during data import. The program allows as many as ten data files with up to seven indexes each to be opened simultaneously. The data files may hold 500 fields, with over 1,000 fields in all data files combined. A \$369 license, which covers all users in a peer-to-peer or single-server network, is available. The recently announced *VP-Info Professional II Network Edition* will cost \$569. (Sub Rosa Corp., Minneapolis, Minnesota; 800-554-6365, 612-379-3898.) ■

#### FACT FILE

##### *Paradox*, Version 3.5

Borland International Inc., P.O. Box 660001, 1800 Green Hills Rd., Scotts Valley, CA 95066-0001; 408-438-5300.

List Price: \$795; 10 users, \$2,495.

Requires: 640K RAM, DOS 3.1 or later, DOS 3.1-compatible network operating system.

In Short: *Paradox* is a capable multiuser database with strong query support and an easy-to-understand table metaphor. But it needs a more modern interface and better development tools.

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product, provides transparent access to data stored in the Microsoft SQL Server, Oracle Server, IBM Extended Edition Database Manager, Sybase SQL Server, and IBM DB2.

*Paradox* is a capable database management system. With all that it has to offer, it is worth your attention for a small network. When building applications for networks with more than eight active stations, though, you may find that users spend a lot of time waiting for access to records.

## R:BASE

BY HENRY FERSKO-WEISS *R:BASE*, Version 3.1c, makes the creation of databases, forms, and applications wonderfully easy with prompts, menus, and pick lists. About the only way to get faster databases or applications is to buy them ready-made off the shelf. And if you turn to the powerful programming language, you don't need to learn commands and syntax that resemble Sanskrit. The programming language is simple and you can call up screens of sample syntax to help you phrase a command. The one weakness of the program is its debugging facilities, which still need improvement. It performed relatively slowly on PC Magazine Labs' tests, though the current version is a significant improvement over earlier releases.

As a multiuser database, *R:BASE* has two features that make it an outstanding choice above and beyond its other features: It's concurrency control lets multiple users change the same record at the same time and you can operate in a transaction-processing mode that gives you commits and rollbacks.



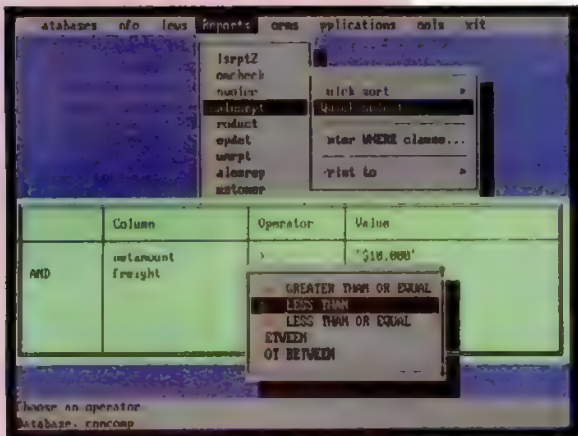
## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES

### CONCURRENCY CONTROL: INTERACTIVE VS. BATCH

*R:BASE*'s multiuser features are designed especially for environments where several people will be working on the same records at the same time. For this reason the program uses concurrency control instead of record locking. With concurrency control, two or more people are allowed to enter data or change information in the same record at the same time. Only if two people attempt to change the same field at the same time is a lock put on the field and the user notified that the data may be modified.

Concurrency control works with forms and the Edit command. In an interactive environment this approach is much more efficient than record locking. However, in an environment that is basically batch oriented *R:BASE* would be slower. Along with concurrency control the program also uses table and database locking automatically where appropriate; or you can manually set a table lock through programming commands.

The transaction processing mode in *R:BASE* gives you the option of processing commands as a group. It's used in situations where a whole series of data entry or data modification operations needs to be completed, but no changes should be made until *all* changes are made. Either all changes are committed at once or all the changes are rolled back. For example, if you are doing year-end posting of accounts to a master account and deleting rows as you go, transaction processing would let you commit all the work at once or roll it back if the process is interrupted at some point.



*R:BASE*'s extensive menu system makes it easy to choose any function, even query operators.

### Suitability to Task

#### **R:BASE**

Multiset access

Data security

Queries

Reporting

Applications development

### TRANSACTION PROCESSING

Aside from its value in maintaining data integrity, transaction processing lets you run several complicated what-if analysis statements before deciding what data to keep. While in the transaction processing mode you have different types of locks than in the normal multiuser mode, there is no concurrency control, and table locks are automatically set for Select, Insert, and Update. There is also a full database lock for a whole range of commands, including Join, Project, Restore, and so on.

*R:BASE* produced mixed results on PC Magazine Labs' tests but was on the slow side across all tests. On the Mixed Workload test, when running without interference, *R:BASE* took the longest of all the programs. Although there was very little degradation with read interference, it slowed considerably when we substituted write requests.

When it came to transactions per second on the Mixed Workload tests, *R:BASE* had the lowest number with read interference but came in fifth with write interference.

To its credit, *R:BASE* has improved its speed since our last review ("15 Relational Databases: Easy Access, Programming Power," May 28, 1991). At that time, it came in last

when producing a report and loading and indexing the 100,000-record database. This time around, it came in next to last

on loading and indexing, but with a time that was nearly four times as fast. On the Report test, it came in around the middle of the pack.

Regardless of whether you're using *R:BASE* as a multiuser or single-user product, you can build databases and applications with great ease. You notice this initially when you design a database. When you select the Create/Modify command, you're guided through a series of menu choices and dialog boxes. Within seconds or minutes (depending on the complexity of the tables), you've defined your database.

The table menu lets you create rules for the database, such as requiring or verifying a value. You can create your own custom rules as well, using conditions for success or failure, which you specify in a dialog box. Having the rules attached to the database rather than to an application gives you more control over data integrity. At the table menu, you can also grant or revoke access rights for selection, updating, insertion, and deletion right down to the individual field item, also using menus that automatically prompt you for input.

The ease of building database tables is replicated throughout *R:BASE*. Whether you're creating forms, views, reports, or applications, the approach is the same. You work from menus that change according to where you are; you're prompted for the next maneuver with highlighted menu items or open-entry fields; you set parameters or variables through pick lists and dialog boxes that pop up automatically as you need them, and context-sensitive or function-key help is always available. It's nearly impossible to make a big mistake, and you can always go back

### FACT FILE

**R:BASE, Version 3.1c**  
Microrim, 15395 S.E. 30th Pl., Bellevue, WA 98007; 206-649-9500.  
**List Price:** Single user, \$795; 5-user LAN pack, \$995.  
**Requires:** 640K RAM, hard disk, DOS 3.1 or later.  
**In Short:** With its concurrency control, *R:BASE* has one of the most advanced locking-control systems of all the products tested. The program also offers transaction processing and faster throughput than earlier versions. All of these features make it an excellent choice as a multiuser database in an interactive environment.

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## APPLICATIONS DEVELOPMENT MULTIUSER DATABASES

and modify your work without trouble.

*R:BASE* has excellent manuals and an extensive tutorial, which makes learning the program a snap. With all of these facilities, even nonprogrammers can build complex applications quite rapidly.

Although some users will find that the menu commands are enough for building their applications, the programming language in *R:BASE* gives you many more facilities. You can design nearly any application you can dream up. It takes relatively few lines of code to perform most operations, so programs are clean and

spare. An application can include dialog boxes, a number of different types of menus, error handling, and screens with both lines and colors.

When you combine the multiuser and single-user capabilities of *R:BASE* it makes for an outstanding program. Its concurrency control in particular gives many users the ability to read, enter, and edit data without bumping into each other and waiting in a queue. And with the program's newfound speed, you no longer

wait as long for an operation to be completed. All the program needs to be a strong contender for top database honors is another boost to the throughput and better debugging facilities.

## Superbase 4

**BY JOE SALEMI** Software Publishing Corp.'s *Superbase 4*, Version 1.3, is unique among the multiuser databases reviewed



### PERFORMANCE TESTS

**No one DBMS excelled on all five of our multiuser database performance tests, which were designed to measure raw speed and to uncover how well each product performed when there was heavy network contention.**

#### Load and Index

Only one product, *FoxPro/LAN*, took less than an hour to load and index the 200,000-record test database. The slowest product by far was *Advanced Revelation*, taking almost 18 hours to complete the chore. The average time was just under 7 hours.

Although we allowed vendors a wide choice of indexes, all of them elected to use B-trees. *Paradox* builds a special form of B-tree called a *clustering index*, which physically arranges the data in indexed order rather than merely generating an ordered set of pointers to it. Clustered

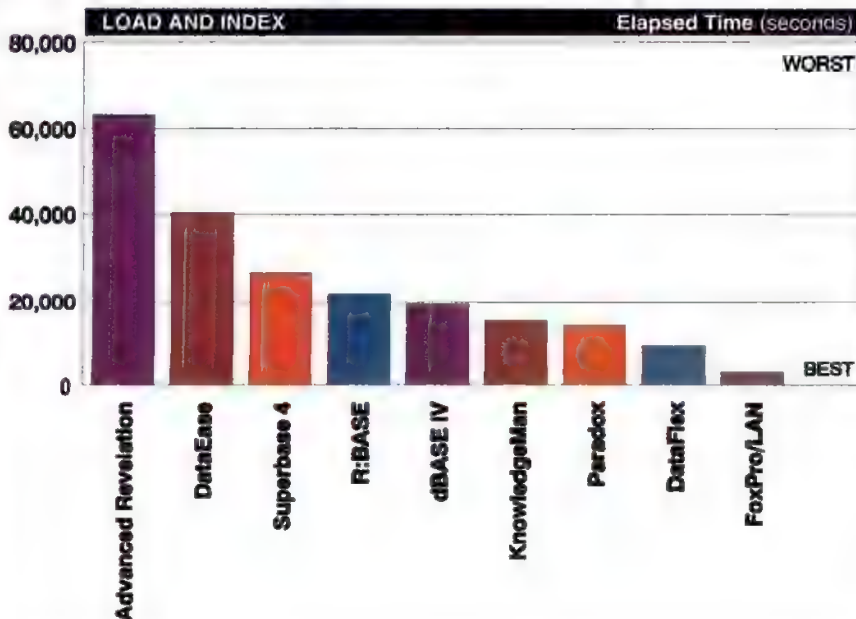
indexes take longer to build than non-clustered indexes—about three times as long in the case of *Paradox*—but they are significantly faster at retrieving sequential data.

*Advanced Revelation's* import performance was similarly impacted by hashing on the primary key. Like a clustering index, *Revelation's* hashing algorithm physically arranges the data. Unlike an index, however, hashing does not realize any performance gain for sequential reads, since the data is not ordered in any sequence a user is likely to need. The performance

benefit for *Revelation* is in its variable-length architecture, which is ideally suited for a database that is constantly changing its size.

The Load and Index test measures how quickly a database package can import and index a two-table database with 100,000 records per table. The first table contains six indexes and the second contains three; the indexes are built according to each vendor's recommendations. If a package performs faster by loading and indexing simultaneously, we define indexes prior to loading the data. Otherwise, indexes are generated after the data is loaded.

The packages must import randomly ordered records from comma-delimited ASCII files. To test the versatility of the import routines, we do not enclose text fields in quotation marks. All of the packages except *Paradox* were able to import the data in this format. *Paradox* could only import comma-delimited, quoted ASCII files.



#### LOAD AND INDEX

Elapsed Time (hours:minutes:seconds)

|                     |          |
|---------------------|----------|
| Advanced Revelation | 17:37:05 |
| DataEase            | 11:11:22 |
| Superbase 4         | 07:22:07 |
| R:BASE              | 06:01:26 |
| dBASE IV            | 05:24:00 |
| KnowledgeMan        | 04:15:56 |
| Paradox             | 03:59:10 |
| DataFlex            | 02:39:05 |
| FoxPro/LAN          | 00:53:50 |

Shorter times represent better performance.

CONTINUES



## PERFORMANCE TESTS

## Random Read

All of the products generally turned in excellent performance on this test. We anticipated that the test would overload our file-server PC databases with fewer than eight workstations, because when it was run on a Unix-based VAX minicomputer, the maximum throughput was achieved with only two workstations. The test puts a significant load on a server with relatively few users: Only a few milliseconds separate each transaction from the next, and the amount of queries generated by one workstation is roughly equivalent to what ten very fast human operators could enter in the same amount of time.

Even with 24 workstations running, *dBASE IV* (Server Edition), *FoxPro/LAN*, *Superbase 4*, *KnowledgeMan*, and *Advanced Revelation* had still not reached their peaks. *DataFlex*, *DataEase*, and *R:BASE* were at their maximum throughput and going strong. Only *Paradox* was falling off in performance (it peaked after six users were added).

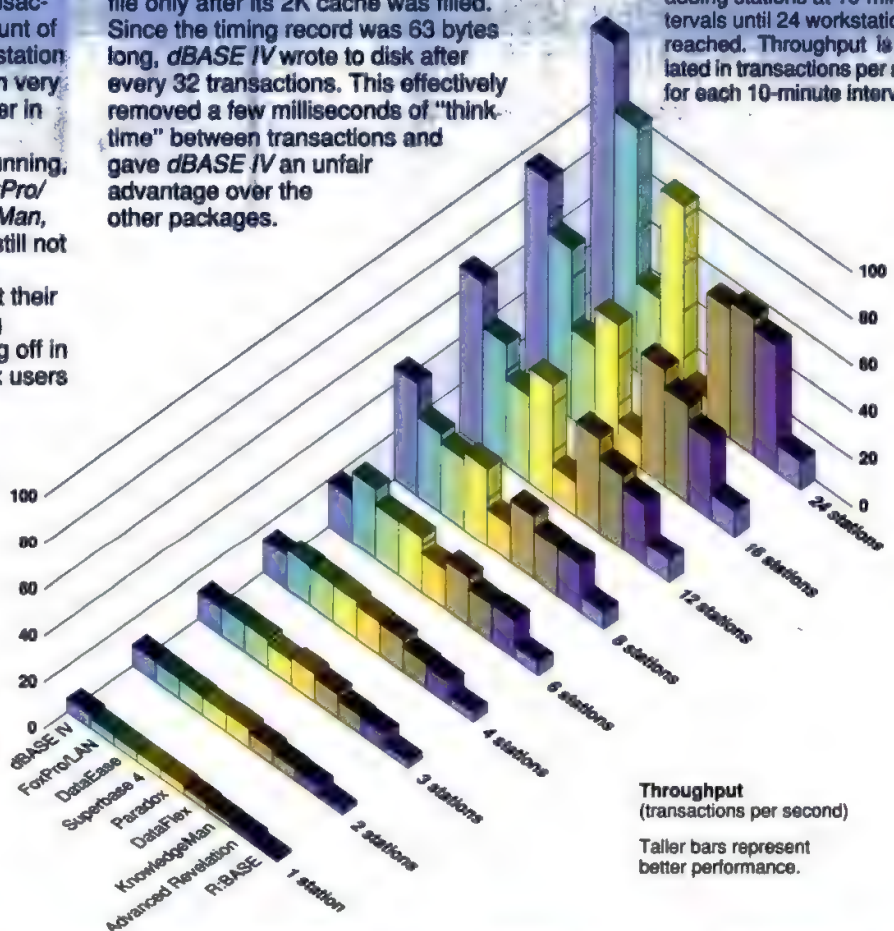
*Paradox* always writes the results of a query to disk in a temporary table, regardless of the output mode. While this feature is convenient for standalone users, it has a debilitating effect on network performance. Borland recommends configuring the system so that temporary tables are written to a local hard disk, but for large databases or disks with a small amount of working space, this is impractical. For our tests, the local disks were reserved for timing files only.

Although the chart accurately implies that *dBASE IV*

had not yet reached its peak throughput with 24 workstations, its number of transactions per second is misleading compared with the other packages. Its relative performance could not be determined, because it has an internal write cache that we could not disable or replicate for the others. All of the other packages wrote their response times to a local file after each transaction, but *dBASE IV* wrote to the timing file only after its 2K cache was filled. Since the timing record was 63 bytes long, *dBASE IV* wrote to disk after every 32 transactions. This effectively removed a few milliseconds of "think time" between transactions and gave *dBASE IV* an unfair advantage over the other packages.

The **Random Read** test shows the maximum number of concurrent retrievals that the system can handle in batch-processing mode. In this test, each workstation randomly selects single records from the same file and discards the results (that is, output is directed to device NUL). Records are accessed in browse mode, which permits the greatest amount of data sharing.

We run the test for 90 minutes. To determine where peak throughput occurs, we increase the number of workstations gradually, adding stations at 10-minute intervals until 24 workstations are reached. Throughput is calculated in transactions per second for each 10-minute interval.



## RANDOM READ

| Throughput<br>(transactions per second) | 1 station | 2 stations | 3 stations | 4 stations | 6 stations | 8 stations | 12 stations | 16 stations | 24 stations |
|-----------------------------------------|-----------|------------|------------|------------|------------|------------|-------------|-------------|-------------|
| <b>dBASE IV</b>                         | 5.96      | 9.05       | 11.78      | 14.45      | 18.88      | 47.67      | 70.96       | 94.63       | 132.59      |
| <b>FoxPro/LAN</b>                       | 4.59      | 8.66       | 12.46      | 16.90      | 30.18      | 33.52      | 51.73       | 72.49       | 103.97      |
| <b>DataEase</b>                         | 4.19      | 8.38       | 12.45      | 16.38      | 23.64      | 29.72      | 36.57       | 38.16       | 38.32       |
| <b>Superbase 4</b>                      | 4.15      | 7.92       | 10.53      | 16.11      | 23.89      | 32.75      | 48.34       | 54.22       | 85.04       |
| <b>Paradox</b>                          | 4.14      | 8.33       | 12.13      | 14.27      | 16.63      | 15.94      | 14.40       | 12.82       | 10.27       |
| <b>DataFlex</b>                         | 3.41      | 6.83       | 10.52      | 13.95      | 20.67      | 27.08      | 40.03       | 49.45       | 55.28       |
| <b>KnowledgeMan</b>                     | 2.75      | 5.48       | 8.20       | 10.84      | 16.14      | 21.34      | 31.50       | 41.37       | 58.64       |
| <b>Advanced Revelation</b>              | 2.47      | 4.96       | 7.50       | 9.81       | 16.60      | 20.64      | 26.74       | 33.46       | 54.02       |
| <b>R:BASE</b>                           | 0.96      | 1.92       | 2.85       | 3.76       | 5.54       | 7.19       | 9.82        | 11.22       | 11.97       |

Higher scores represent better performance.

CONTINUES

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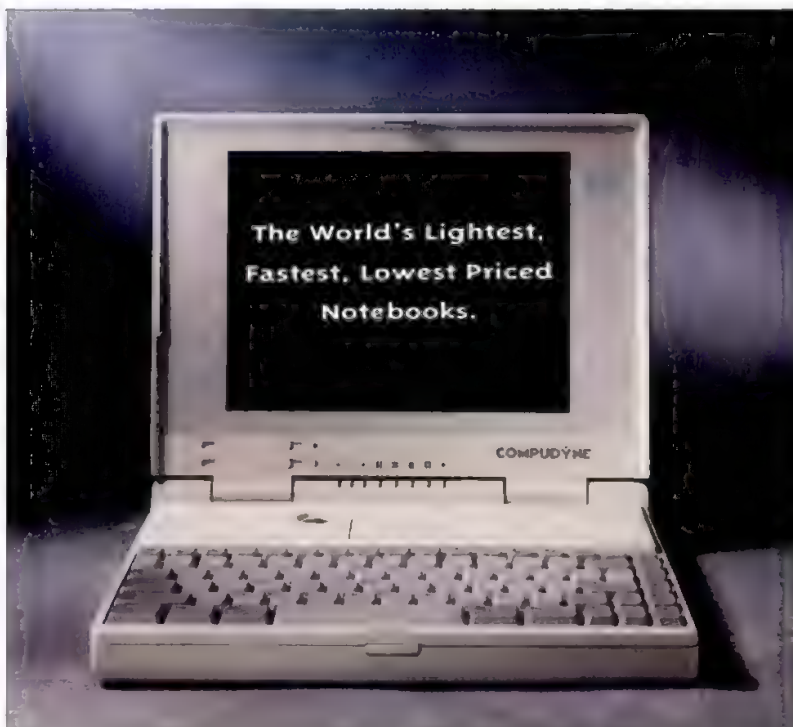
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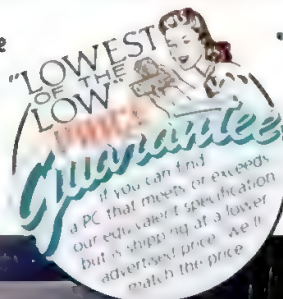
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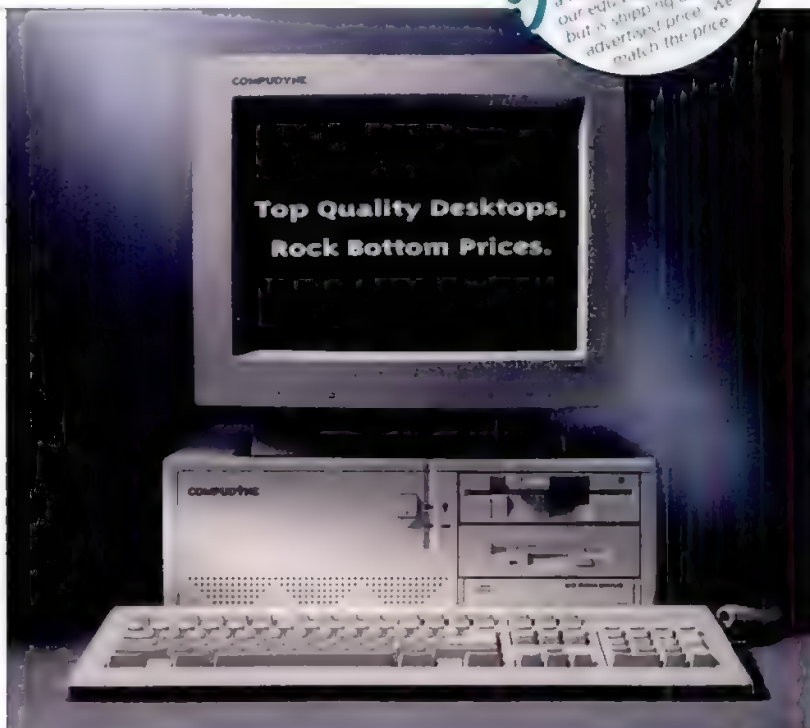
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| <b>386DX/25</b>            | Intel 80386DX-25 MHz                                            | 2 standard<br>32 max | 80                  | 1.2 and 1.44 | 16 bit SVGA card<br>14" 1024 x 768 SVGA<br>color monitor                                                                 | <b>\$1,399</b><br><b>\$52/mo*</b>  |
| <b>386DX/33<br/>CACHE</b>  | Intel 80386DX-33 MHz<br>32K CPU cache                           | 4 standard<br>32 max | 120                 | (as above)   | 16 bit SVGA card<br>w/ 1MB video RAM<br>& 32,000 color support<br>14" 1024 x 768 SVGA<br>non-interlaced<br>color monitor | <b>\$1,799</b><br><b>\$67/mo*</b>  |
| <b>486DX/33<br/>CACHE</b>  | Intel 80486DX-33 MHz<br>128K CPU cache                          | 4 standard<br>64 max | 120                 | (as above)   | (as above)                                                                                                               | <b>\$2,199</b><br><b>\$81/mo*</b>  |
| <b>486DX2/50<br/>CACHE</b> | Intel 80486DX2-50 MHz<br>128K CPU cache<br>New Double Clock CPU | 4 standard<br>64 max | 210                 | (as above)   | (as above)                                                                                                               | <b>\$2,999</b><br><b>\$111/mo*</b> |

\*Leasing arranged through Leasing Group, Inc. payments based on 36 month open-end rate

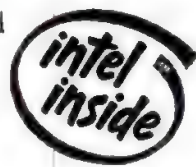
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CIRCLE 132 ON READER SERVICE CARD

## PERFORMANCE TESTS

### Random Write

The Random Write test places a considerably higher load on a system than the Random Read test, since it not only reads the data file but updates that file and an index as well. Data sharing is also more restrictive, so it is no surprise that throughput for updates in this test is lower than for retrievals (as indicated by the Random Read test).

Generally, the more users who have concurrent access to data, the higher the throughput. Sophisticated concurrency controls allow multiple users write access to all but the items being updated. Less sophisticated locking systems will deny users access even to items that are not being updated. *DataEase*, for example, locks the entire data file, so only one station has write access at a time,

and *DataEase*'s throughput on this test is noticeably low.

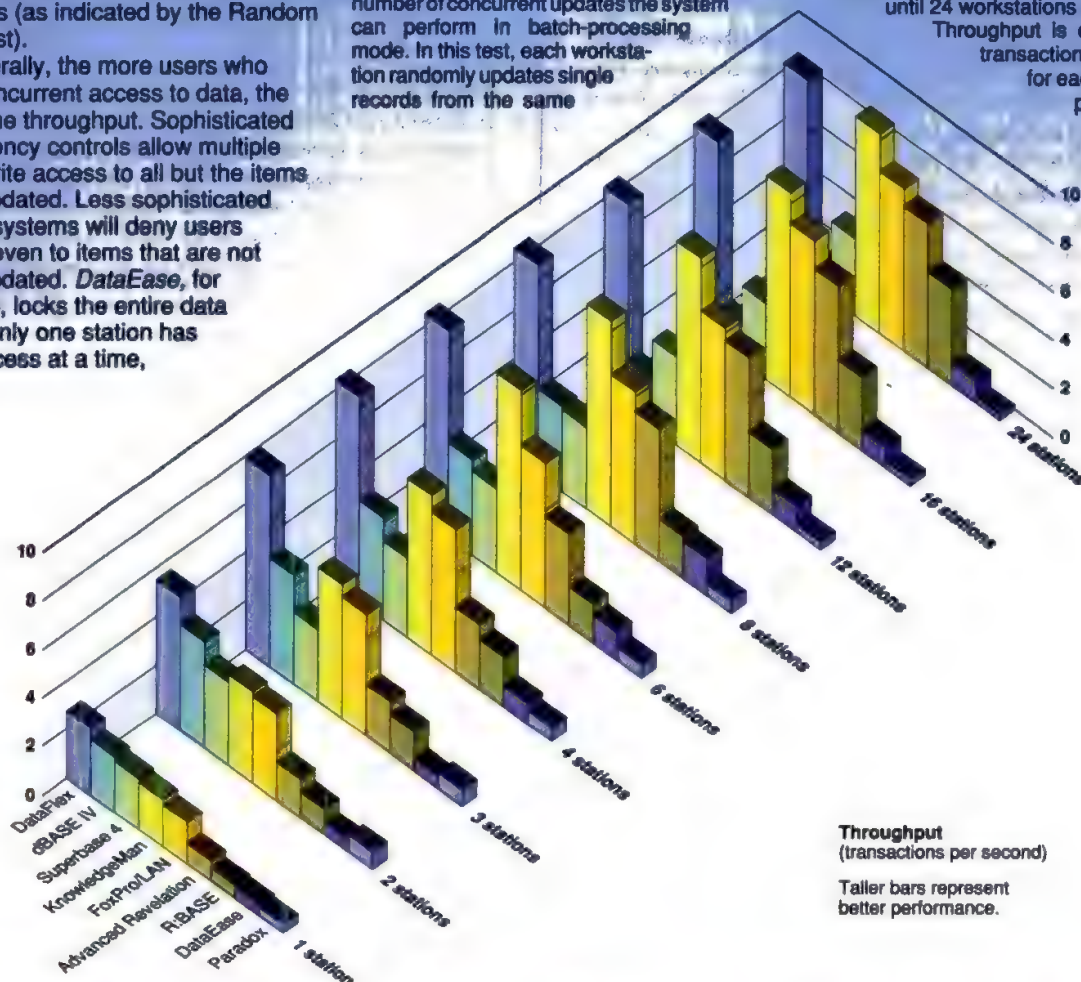
As with the Random Read test, the throughput values for *dBASE IV* are not comparable with those of the other packages because of internal disk caching.

The Random Write test shows the maximum number of concurrent updates the system can perform in batch-processing mode. In this test, each workstation randomly updates single records from the same

file. The value of a nonkey indexed field is modified so that both the record and the index must be updated. Records are accessed in update mode, which permits data sharing in the file but does not allow anyone else to access a record that is being updated.

We run the test for 90 minutes. To determine where peak throughput occurs, we increase the number of workstations gradually, adding stations at 10-minute intervals until 24 workstations are reached.

Throughput is calculated in transactions per second for each 10-minute period.



Throughput  
(transactions per second)

Taller bars represent  
better performance.

### RANDOM WRITE

Throughput  
(transactions per second)

|                     | 1 station | 2 stations | 3 stations | 4 stations | 6 stations | 8 stations | 12 stations | 16 stations | 24 stations |
|---------------------|-----------|------------|------------|------------|------------|------------|-------------|-------------|-------------|
| DataFlex            | 2.75      | 5.50       | 7.90       | 8.41       | 8.51       | 8.60       | 8.48        | 8.43        | 8.28        |
| dBASE IV            | 2.26      | 4.39       | 4.45       | 4.18       | 3.94       | 3.45       | 1.89        | 1.49        | 1.07        |
| Superbase 4         | 2.10      | 3.44       | 2.96       | 3.24       | 3.50       | 3.34       | 3.58        | 3.17        | 3.18        |
| KnowledgeMan        | 1.97      | 3.76       | 5.50       | 6.57       | 8.18       | 8.42       | 8.39        | 8.45        | 8.26        |
| FoxPro/LAN          | 1.76      | 3.55       | 5.00       | 5.85       | 5.97       | 6.20       | 6.21        | 7.16        | 6.70        |
| Advanced Revelation | 0.85      | 1.57       | 2.14       | 2.67       | 3.75       | 5.41       | 5.69        | 6.02        | 5.97        |
| R:BASE              | 0.56      | 1.09       | 1.60       | 2.08       | 1.57       | 1.73       | 2.67        | 2.98        | 3.97        |
| DataEase            | 0.47      | 0.51       | 0.46       | 0.88       | 1.15       | 1.55       | 1.08        | 0.84        | 0.91        |
| Paradox             | 0.37      | 0.71       | 0.65       | 0.57       | 0.55       | 0.47       | 0.28        | 0.23        | 0.19        |

Higher scores represent better performance.

CONTINUES



## PERFORMANCE TESTS

### Mixed Workload

The Mixed Workload tests reveal the degree to which the system allows data sharing and the impact that has on response time. To judge this, you need to look at the results in two ways: how much total work was done (shown in the Throughput chart on the facing page) and how long a single station took to complete its work (the Elapsed Time chart).

Since the Throughput chart shows the amount of work accomplished, and

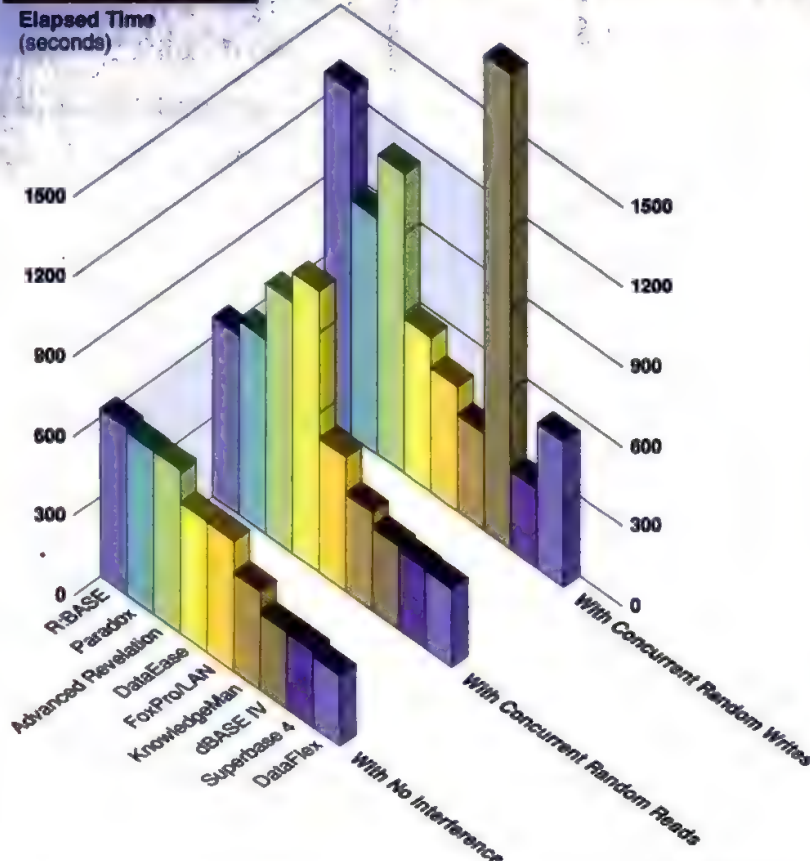
since that number is affected by the number of users generating work, it indirectly tells you about the system's concurrency control. Look at the results of the Concurrent Random Reads test to determine how much throughput you can expect from a database system when a variety of users are reading from but not writing to a large database.

The results of the Concurrent Random Writes test, on the other

hand, show the sophistication of the systems' locking schemes, since the operations require the highest level of isolation from one another. For the latter test, packages with limited locking capabilities will simply lock all but one user out of the file. The way to judge whether much concurrent processing is taking place is to compare a package's Concurrent Random Reads throughput with its Concurrent Random Writes throughput. If the difference is very high, the system is probably locking the file and processing one request at a time. This is obviously the case for *dBASE IV*, *FoxPro/LAN*, and *Paradox*. (As previously explained, *dBASE IV*'s throughput values are misleading because of caching distortion.) If, on the other hand, the percentage is closer to 50 percent—as is the case with *Advanced Revelation*, *DataFlex*, and *R:BASE*—much more work is being done concurrently.

Neither *dBASE IV* nor *FoxPro/LAN* can coordinate file and record locks: Record locks are always given priority. In order to finish the Mixed Workload tests with random reads and random writes, *FoxPro/LAN* had to use file locks even for stations running the Random Read and Random Write tests. Otherwise, the stations with record locks would keep the station running the mixed workload waiting for a file lock indefinitely.

### MIXED WORKLOAD



Shorter bars represent better performance.

### MIXED WORKLOAD

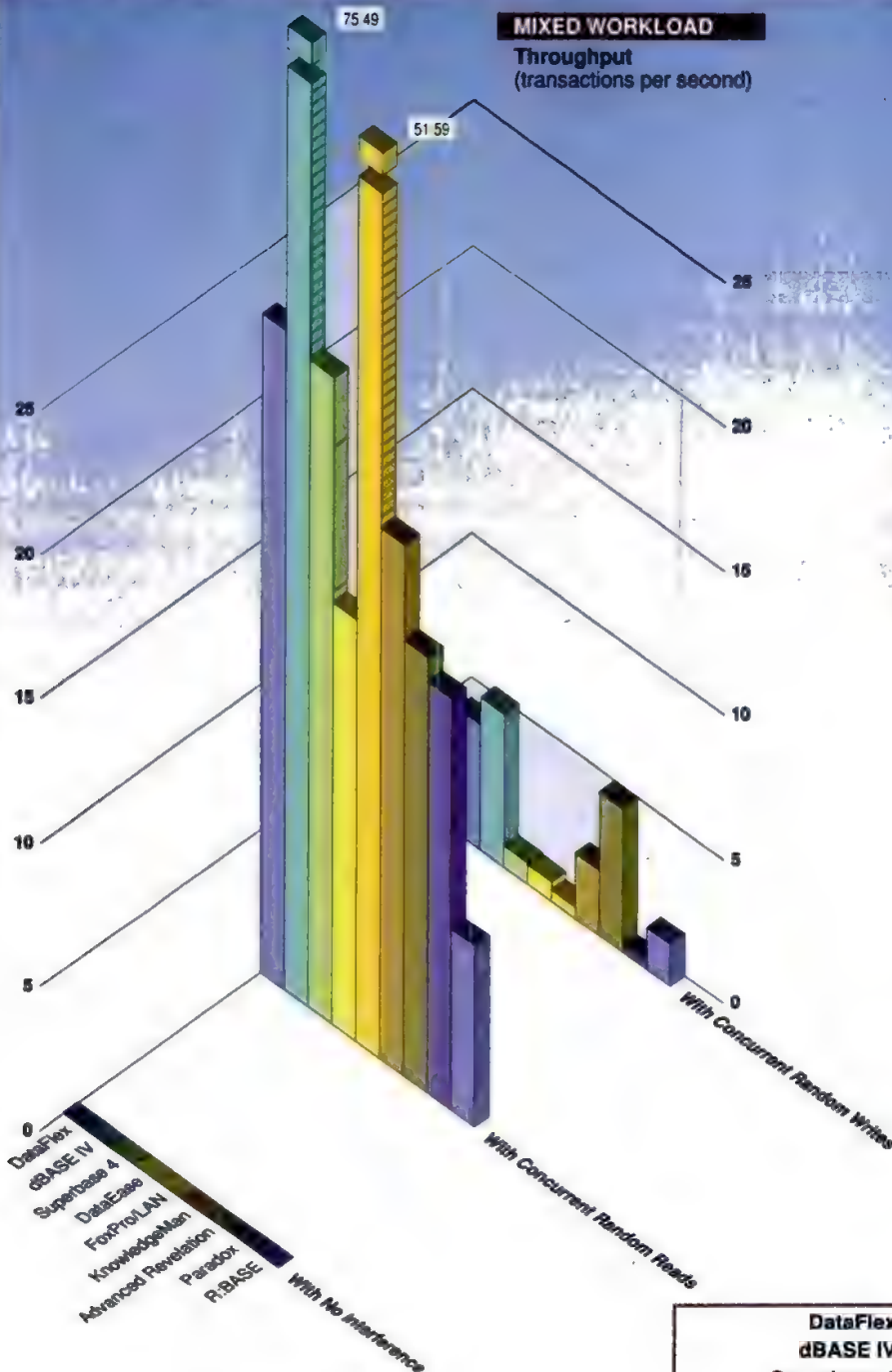
Elapsed Time (minutes:seconds)

|                     | With No Interference | With Concurrent Random Reads | With Concurrent Random Writes |
|---------------------|----------------------|------------------------------|-------------------------------|
| R:BASE              | 10:34                | 11:16                        | 21:32                         |
| Paradox             | 10:17                | 12:12                        | 14:46                         |
| Advanced Revelation | 10:12                | 15:44                        | 18:47                         |
| DataEase            | 8:10                 | 17:36                        | 9:42                          |
| FoxPro/LAN          | 8:08                 | 8:26                         | 7:50                          |
| KnowledgeMan        | 6:10                 | 6:07                         | 6:06                          |
| dBASE IV            | 4:50                 | 5:11                         | 29:42                         |
| Superbase 4         | 4:50                 | 5:00                         | 4:58                          |
| DataFlex            | 4:29                 | 4:53                         | 9:08                          |

Shorter times represent better performance.

# APPLICATIONS DEVELOPMENT

## MULTIUSER DATABASES



Taller bars represent better performance.

The **Mixed Workload** tests show the effect data sharing has on response time and throughput. There are three Mixed Workload tests in the suite: With No Interference, With Concurrent Random Reads, and With Concurrent Random Writes. The results are reported in terms of both elapsed times and throughput rates, in separate graphs.

In the **No Interference** test, a single workstation runs a mixed workload of eight database operations, including queries, updates, and an aggregate report joining two tables. Locking for these operations is set to the highest degree of isolation (that is, no one may read uncommitted updates, and no one may update the file to change the results of a query or report). We record the total time to run all eight operations, and compute the average number of transactions per second.

In the **Concurrent Random Reads** test, we run the Random Read queries on seven workstations. After 10 minutes, we add an eighth station running the same Mixed Workload routines as in the No Interference test. When the eighth station finishes, we stop all stations and record the total time that the eighth station took to complete its routines. To compute throughput, we divide the total number of transactions all eight stations performed by the total test time. (The first 10 minutes of work are performed to stabilize the network and the results are discarded.)

The **Concurrent Random Writes** test is the same as the Concurrent Random Reads test, but instead of running the Random Read queries, we run the Random Write transactions.

The Random Read and Random Write stations access just one of the two tables; the Mixed Workload station accesses both tables.

### MIXED WORKLOAD

Throughput (transactions per second)

|                     | With No Interference | With Concurrent Random Reads | With Concurrent Random Writes |
|---------------------|----------------------|------------------------------|-------------------------------|
| DataFlex            | 0.03                 | 22.87                        | 4.30                          |
| dBASE IV            | 0.03                 | 75.49                        | 5.25                          |
| Superbase 4         | 0.03                 | 22.40                        | 0.75                          |
| DataEase            | 0.02                 | 14.62                        | 0.69                          |
| FoxPro/LAN          | 0.02                 | 51.59                        | 0.40                          |
| KnowledgeMan        | 0.02                 | 18.40                        | 2.28                          |
| Advanced Revelation | 0.01                 | 15.10                        | 4.96                          |
| Paradox             | 0.01                 | 14.25                        | 0.27                          |
| R:BASE              | 0.01                 | 6.30                         | 1.48                          |

Higher scores represent better performance.

CONTINUES



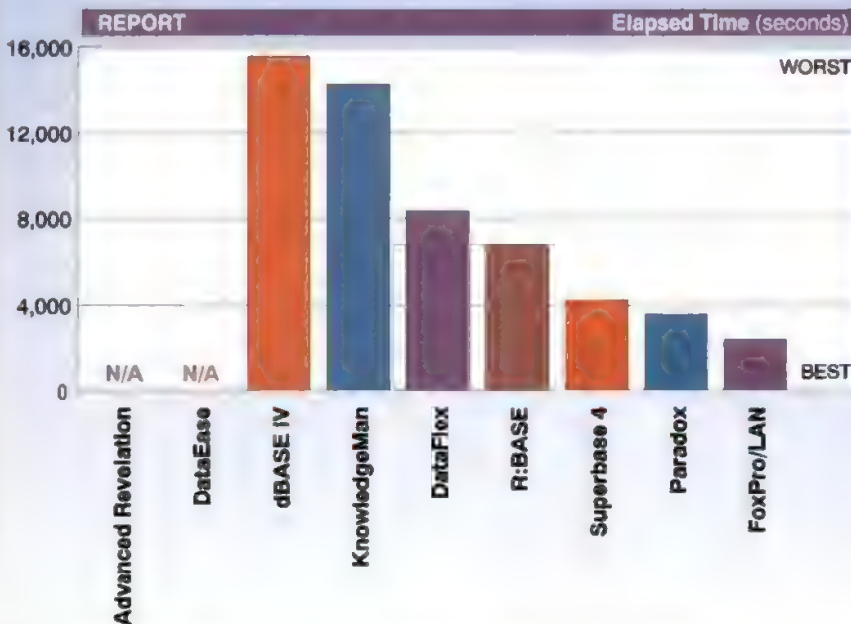
## PERFORMANCE TESTS

## Report

Two of the products, *Advanced Revelation* and *DataEase*, could not complete the Report test within the 5-hour time limit. The report is complex; it involves joining two huge tables, and neither of these packages moves large amounts of data with ease. The problem was compounded by having

seven other workstations competing for access to one of the files. *KnowledgeMan* and *Paradox* took half of their processing time to join the tables. A good indicator of the task's difficulty is that *FoxPro/LAN* took almost as long to run this report as to load and index the entire database.

For the **Report** test, one workstation prints a report while seven other workstations perform the Random Read test in the background. We placed a 5-hour time limit on the test. To produce the report, the product has to join two tables into a 100,000-record view and then generate a 1,000-row summary using sorted break fields, date calculations, minimum and maximum values, subtotals, and totals. The report also requires customized output formats, headers, footers, and pagination. The results are output to a network print queue.



N/A—Not applicable: This product could not complete the test within our 5-hour limit

## REPORT

Elapsed Time  
(hours:minutes:seconds)

|                     |          |
|---------------------|----------|
| Advanced Revelation | N/A      |
| DataEase            | N/A      |
| dBASE IV            | 04:19:51 |
| KnowledgeMan        | 03:57:35 |
| DataFlex            | 02:19:15 |
| R:BASE              | 01:53:07 |
| Superbase 4         | 01:10:59 |
| Paradox             | 00:59:17 |
| FoxPro/LAN          | 00:39:55 |

Shorter times represent better performance.

CONTINUES

here in one important respect: It's the only product based on Microsoft Windows 3.0. The GUI support makes designing databases, forms, and reports a mostly point-and-shoot affair, and it provides full sup-

port for DDE connections to other Windows applications, as well as optional links to SQL database servers. Its market, however, is limited to those machines that have the ability to run Windows, and the 2MB RAM recommendation for best performance requires a 286-based or better processor to the workstation.

A single-user *Superbase 4* package (\$695) is required to provide the base support files; multiuser support is provided by additional 5-user bump packs costing \$1,495, which limits only concurrent users rather than the number of user IDs. The theoretical maximum number of concurrent users is 32,000, though the practical limit is much lower, depending on database size and network overhead. Available memory and disk space govern maximum database size; 16 million records per database is the practical limit.

## THREE LEVELS OF PASSWORDS

Three password-protected security levels are provided: Delete access gives users full rights to the database; Read and Write access lets users update records without the ability to delete them; and Read Only prevents users from updating records. The only security at the field level is provided through developer-created forms that are part of an application. This means that users with access to the full *Superbase 4* environment can completely browse any databases that they have the passwords to, which can be a problem when confidential data is involved. User names are governed by either a DOS environment variable, or a variable in the WIN.INI file.

Four high-level concurrency controls exist, with various sublevels that govern read and write privileges. At the highest level, all users can read and write to the



## FACT FILE

## Superbase 4, Version 1.3

Software Publishing Corp., 3165 Kifer Rd., Santa Clara, CA 95051; 408-986-8000.

**List Price:** Single user, \$695; network pack (additional 5 users), \$1,495.

**Requires:** 640K RAM (2MB recommended), hard disk, Microsoft Windows-compatible graphics monitor, DOS 3.3 or later, Windows 3.0, mouse.

**In Short:** *Superbase 4* is a powerful multiuser database that takes full advantage of Windows' capabilities for designing and running applications.

CIRCLE 497 ON READER SERVICE CARD

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## PERFORMANCE TESTS

## HOW WE TESTED

We tested the databases reviewed in this story on a three-ring, 16Mb Token-Ring LAN operating under *NetWare 386*, Version 3.11. Each ring comprised a server and eight workstations. Each of the servers was a Compaq Systempro 486 configured with 16MB and two Systempro drive arrays, for a total capacity of 1.6 gigabytes of storage per server. The Compaq Deskpro 386/25n workstations were configured with 5MB and 40MB hard disks formatted under Compaq DOS 5.0. Most of the tests were conducted with eight workstations and a server on a single, isolated ring. When tests required 24 stations, we connected the rings and disconnected two of the servers.

We adapted these performance tests from the AS<sup>2</sup>AP (ANSI SQL Standard Scalable and Portable) Benchmark Tests for Relational Database Systems, developed by Carolyn Turbyfill, Dina Bitton, and Cyril Orji at Cornell University. Turbyfill, currently of Sun Microsystems, assisted us in adapting the multiuser tests for PCs. The tests are in the public domain and can be obtained by contacting Dina Bitton at Cadre Technologies, 4500 Bohanon Dr., Palo Alto, CA 94025; 415-328-0601.

Although the tests are written in SQL, we did not require the database products to support that language, nor to be relational. We aimed to achieve the same results that would be produced by the SQL operation, using the technique best suited to each product.

Each of the nine companies commissioned a programmer to write code in its product's language, in line with these instructions. Each of the test modules automatically timed the duration of the transaction. We then posted the results to a timing file on the local hard disk.

We permitted the vendors to use the memory managers HIMEM.SYS, EMM386.EXE, or CEMM.EXE in their configurations. *Superbase 4*, a Windows package, used SMARTDRV.SYS, the Windows disk-caching utility, but otherwise we did not allow local disk-caching software. Since only the timing file was located on the local drive, disk caching could not have enhanced any product's performance, and write caching would confound the timing process. SMARTDRV.SYS does not cache writes and did not affect timing, but *dBASE IV* has an

internal write cache that is used whenever output is redirected to a file. This affected its results on some of our tests, and the effect is noted where applicable.

The test database contained two tables of 100,000 records each. The tables contained different data, and the number of indexes varied, but both conformed to the structure shown in Figure 1.

The average record length was 100 bytes, but this varied depending on the product's storage capabilities. If the package did not support the specified data type, it usually paid a penalty in additional storage. For example, a long integer data type requires 4 bytes of storage (a long integer can be a value up to 1 billion). A package that does not support integers but instead uses numeric characters must

allocate 10 or 11 bytes to store the same amount of data. Thus, it pays a storage penalty of 6 or 7 bytes per record. If a product did not support any of our required data types and used less than 100 bytes per record, it had to import an additional FILL field to make up the difference.

We specified a total of nine indexes for the database, most of them on unique values. We permitted the use of access methods such as hashing or linked lists, even though they are not true indexes. If the package supported clustered indexes, we asked that they be placed on the primary key of each file. Otherwise, we did not tell the programmer what type of index to use. The tables and the indexed fields conformed to the structure outlined in Figure 2.

Figure 1: Database Structure and Data Ranges

| Field name        | Data type                       | Data range/length               |
|-------------------|---------------------------------|---------------------------------|
| KEY (primary key) | Unsigned integer                | 0 to 1 billion                  |
| INT               | Integer                         | 0 to 1 billion                  |
| SIGNED            | Signed integer                  | -1 billion to 1 billion         |
| FLOAT             | Single-precision floating-point | -1.2 billion to 1.2 billion     |
| DOUBLE            | Double-precision floating-point | -1.2 billion to 1.2 billion     |
| DECIM             | Fixed decimal                   | -1 billion to 1 billion         |
| DATE              | Date                            | 01/1/1900 to 12/1/2000          |
| CODE (Alt key)    | Fixed character                 | 10 alphanumeric characters      |
| NAME              | Fixed character                 | 20 alphanumeric characters      |
| ADDRESS           | Variable character              | 2 to 80 alphanumeric characters |
| FILL              | Fixed character                 | 6 characters                    |

Figure 2: Tables and Indexes

| Table name | Indexed field | Function      | Unique values |
|------------|---------------|---------------|---------------|
| HUNDRED    | KEY           | Primary key   | Yes           |
|            | CODE          | Alternate key | Yes           |
|            | NAME          |               | No            |
| UPDATES    | KEY           | Primary key   | Yes           |
|            | CODE          | Alternate key | Yes           |
|            | INT           |               | Yes           |
|            | SIGNED        |               | Yes           |
|            | DOUBLE        |               | No            |
|            | DECIM         |               | No            |

ENDS

*Superbase 4 is  
excellent for those  
looking to move their  
databases to Windows.*

database at the same time; only the records being updated are locked, though they still can be read by other users. An Auto Update option controls whether other users viewing a locked record see the changes made when it's saved. The next level of concurrency is similar, except that when one user runs a query, all of the records are locked until the query is complete. This second level provides the maximum protection for data consistency.

The final two levels are Exclusive Write and Exclusive Open. The former lets only one user write to the file, with all other users able to read it. Exclusive Open restricts the database to one user at a time, and is designed primarily for batch or maintenance processes, such as creating new indexes, mass updates or deletions, and packing the database.

Access levels can be controlled directly through an application or the user can be given the choice of concurrency level when opening the file. The access rights menu is dynamic and lists only the currently available modes when it pops

up. When a record is locked, other users attempting to edit that record are notified about who is holding the lock.

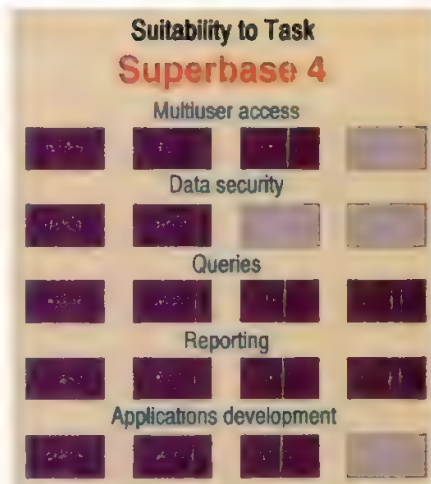
Other than the enforced data consistency controls, *Superbase 4* provides no transaction or data recovery processing; changes are made to the database as soon as the user saves the record. A limitation developers should be aware of while designing applications is that the Forms Designer module doesn't lock the forms while they are being edited. This can cause problems if users are editing it at the same time, or if other users are accessing the form while it is being edited.

#### PERFORMANCE AND APPLICATIONS DEVELOPMENT

*Superbase 4*'s performance on PC Magazine Labs' tests was steady: Its results placed it solidly in the middle of the pack on all of them. It did especially well on the Mixed Workload tests, which look at concurrent file access. Its performance remained strong as we increased the number of users on tests; multiple users had negligible impact on access speeds, and deadlocks were easily avoided through a combination of built-in retries and programming control.

In addition to its proprietary database format, *Superbase 4* has the ability to use *dBASE III* and *IV* data files, including lookups and multifile reports on a read-only basis. An additional SQL Library module (\$495) lets *Superbase 4* act as a front end to a number of database servers, including the Microsoft SQL Server, Oracle, Gupta's SQL-Base, and XDB. It also provides full DDE support, giving it the ability to share data with other Windows applications. A number of different file types can be imported or exported, including ASCII (fixed or delimited), .DBF, .DIF, and .WK1. With Version 1.3 there are additional built-in communications capabilities so that data can be transferred via modem from other sites to a central data collection point.

Another type of link is provided through the external file field type. This lets the developer link a particular record to an

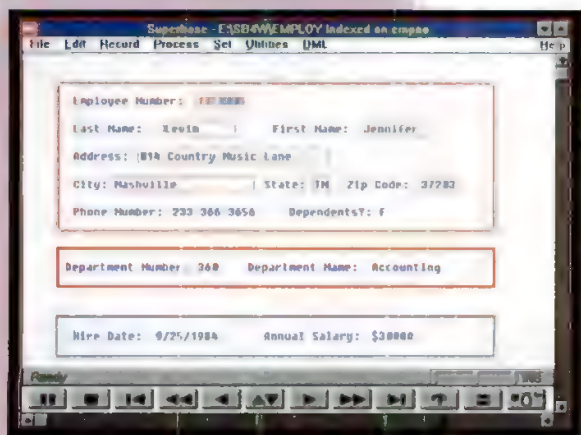


external text file, or more important, to an external graphics file. The graphics images are displayed on the screen along with the record they are attached to, making *Superbase 4* ideal for such applications as personnel identification or parts inventories.

Its Database Management Language (DML) is a superset of structured BASIC with over 200 different commands; it also has a built-in debugger that provides single-step execution. Commands can be directly entered through a DML command window, and applications are written through the built-in program editor. Once written, the DML programs are tokenized to speed execution.

The Forms Designer module is a paint-style program that uses Windows to its best advantage, through a toolkit bar, pop-up selections, graphics, and full point-and-drag mouse capabilities. Creating a multifile form is easy; links between various files are created through pop-up selection lists and are graphically displayed for reference. Reports can either be designed through the Forms Designer, or programmed directly in DML. Reports are automatically treated as queries at runtime, preventing other users from updating records while they're being processed.

Though its GUI orientation may take some getting used to, *Superbase 4* is an excellent choice for those looking to move their databases to the Windows environment. Powerful multiuser applications can be created easily, and the ability to display on-screen graphics as part of the database makes it ideal for certain applications. The optional links to a number of SQL database servers are also a plus for those considering a move to a client/server platform. ■



With the help of Microsoft Windows, *Superbase 4* provides the full range of GUI tools, including graphical forms design. In spite of the graphics environment, *Superbase 4* demonstrates strong speed.



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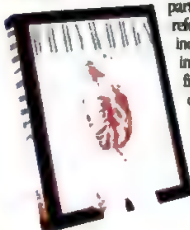
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# \$259

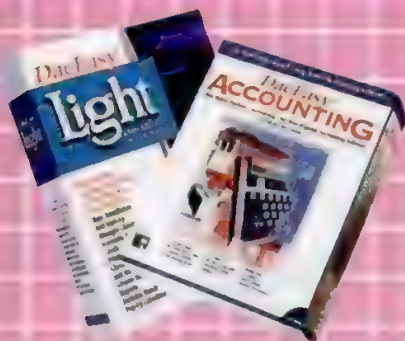


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# \$49



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WristSaver AC4090 (Red) \$13.

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|                     | SIPPS, SIMMS, DRAMS     | Call |
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| MY0013              | SIMM 1MB 100ns          | 35   |
| MY0005              | SIMM 1MB 70ns           | 63   |
| MY0004              | SIMM 1MB 60ns           | 59   |

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| <b>ATI Technologies</b>     |                                 |     |
| EX2020                      | ATI BS14 Ultra                  | 565 |
| EX2010                      | VGA Stereo FX                   | 325 |
| <b>Avivex</b>               |                                 |     |
| EX1940                      | Desktop TV VG1                  | 299 |
| <b>Boca Research</b>        |                                 |     |
| EX1840                      | BRAT90 with OK                  | 115 |
| <b>Brown - Wagh</b>         |                                 |     |
| EX1510                      | MIDI Connector for SoundBlaster | 59  |
| BN0910                      | Sound Blaster                   | 115 |
| EX1800                      | Sound Blaster Pro               | 205 |
| <b>Digital Vision</b>       |                                 |     |
| EX1195                      | ComputerEyes Prof. Series       | 359 |
| EX1610                      | ComputerEyes Color/RT           | 529 |
| <b>Media Vision</b>         |                                 |     |
| CD0320                      | Multi Media Upgrade Kit         | 829 |
| EX1580                      | ProAudio Spectrum               | 259 |
| <b>Parsons Technologies</b> |                                 |     |
| EX2060                      | PC Speakers                     | 179 |
| <b>Star Electronics</b>     |                                 |     |
| EX1480                      | Stacker 2.0                     | 85  |

#### MEDIA & ACCESSORIES

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| <b>Disks (boxes of 10)</b> |                                       |      |
|                            | BASF, Sony, Maxell and bulk Fuji      | Call |
| <b>Kensington</b>          |                                       |      |
| AC0140                     | Masterpiece Plus                      | 95   |
| <b>LB Innovators</b>       |                                       |      |
|                            | Various Colors Wrist Saver w/MousePad | 21   |
|                            | Various Colors Wrist Saver            | 13   |
|                            | Various Colors Wrist Saver MousePad   | 13   |
| <b>Targus</b>              |                                       |      |
| AC2340                     | Premier Leather Case                  | 169  |
| AC0670                     | Universal Notebook Case               | 66   |

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|-------------------------|------------------------------|-----|
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| DR2060                  | Bernoulli 90MB Cartridge     | 145 |
| DR1970                  | Bernoulli 90MB Transportable | 799 |
| <b>MicroSolutions</b>   |                              |     |
| DR1240                  | backpack 1.4                 | 199 |
| DR1790                  | backpack 2.8MB               | 229 |
| <b>Plus Development</b> |                              |     |
| DR1250                  | HardCard II XL 105 MB        | 469 |
| <b>Teac</b>             |                              |     |
| DR0910                  | Teac 3.5 1.44 FD             | 75  |

#### PRINTERS & CARTRIDGES

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|------------------------------|----------------------------------------------------------|--------|
| <b>Adobe</b>                 |                                                          |        |
| BN0800/70                    | Adobe PostScript Cartridge<br>with Type Cartridge 1 or 2 | 299 ea |
| PR1314                       | ★ATM Plus Pack                                           | 125    |
| <b>Agfa</b>                  |                                                          |        |
| PR2414                       | Styles Unlimited Typefaces                               | 115    |
| PR2434                       | Type Director 2.0                                        | 159    |
| PR2424                       | Type Director 2.0, Styles Unlimited Bundle               | 149    |
| <b>Canon</b>                 |                                                          |        |
| PR1710                       | Auto Sheet Feeder for BJ-10e                             | 72     |
| PR1500/10                    | Bubble Jet BJ-10ex                                       | 325    |
| PR2240                       | Bubble Jet BJ - 300                                      | 459    |
| PR2230                       | Bubble Jet BJ - 330                                      | 599    |
| <b>Citizen</b>               |                                                          |        |
| PR2320                       | GSX-140 Plus Color Printer                               | 339    |
| <b>Epson America, Inc.</b>   |                                                          |        |
| PR1330                       | EPL - 7000 Laser Page Printer                            | 879    |
| <b>IQ Engineering</b>        |                                                          |        |
| PR0610                       | Super Cartridge 2                                        | 299    |
| PR1950                       | Super Cartridge 3 Pro                                    | 299    |
| <b>Pacific Data Products</b> |                                                          |        |
| PR1120                       | 25 Cartridges in One!                                    | 269    |
| PR0910                       | Pacific 4 Memory w/ 2Mb                                  | 145    |

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| PR244L           | PacificPage w/ 124 Plus 2mb | 375 |
| <b>Panasonic</b> |                             |     |
| PR2200           | KX-P1124i Printer           | 299 |
| PR2190           | KX-P2624 Silent             | 469 |

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|                         |                               |     |
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| <b>Hayes</b>            |                               |     |
| FX0020                  | JT Fax 9600B Int              | 379 |
| MM2060                  | OPTIMA 24                     | 159 |
| MM0390                  | OPTIMA 96 V 32                | 149 |
| MM0250                  | Personal Modern 2400 Plus Ext | 499 |
| MM0810                  | Pocket Edition 2400           | 125 |
| MM0210                  | Ultra SmartModem 9600 V 32    | 689 |
| MM0860                  | Ultra 144 V 32 BIS, Ext       | 849 |
| <b>The Complete PC</b>  |                               |     |
| FX0060                  | The Complete Communicator     | 295 |
| FX0040                  | The Complete Fax/9624         | 239 |
| <b>Zoom Telephonics</b> |                               |     |
| MM0690                  | HC2400S w/9600 Sendfax Int    | 95  |
| MM0660                  | MX2400S w/9600 Sendfax Ext    | 99  |
| MM0600                  | Modern V 42bis 2400 Ext.      | 135 |
| MM0820                  | V 32 Turbo 9600 Ext           | 349 |

#### NETWORKING

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| <b>3-Com</b>    |                               |     |
| NT0060          | Ethernet II-Single User       | 199 |
| <b>Artisoft</b> |                               |     |
| NT0110          | Lantastic 2 MBPS Adapter Card | 149 |

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|--------------------|--------------------------------------|-----|
| <b>Apogee</b>      |                                      |     |
| IN2130             | MousePen Professional                | 65  |
| IN2260             | Thumbelina                           | 69  |
| <b>Case</b>        |                                      |     |
| IN2314             | *The Typist Plus Graphics (AT)       | 389 |
| <b>CH Products</b> |                                      |     |
| IN0910             | FlightStick with Falcon 2.0          | 45  |
| <b>Logitech</b>    |                                      |     |
| IN1070             | Scanman 256                          | 269 |
| IN2250             | Trackman Portable                    | 99  |
| <b>Marsink</b>     |                                      |     |
| IN2310             | *Color Artist Hand Scan. for Win 3.0 | 489 |
| IN1040             | M-800 Scanner w/OCR                  | 169 |
| IN2000             | *M-800W Scanner w/Image-m            | 165 |
| IN2070             | M-6000CG ColorArtist w/OCR           | 399 |
| <b>Microsoft</b>   |                                      |     |

#### MONITORS

|                           |                                                   |     |
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| IN0275/84                 | Mouse w/Windows (bus/ser)                         | 145 |
| <b>MicroTouch Systems</b> |                                                   |     |
| IN0810                    | The UnMouse                                       | 165 |
| <b>The Complete PC</b>    |                                                   |     |
| IN2110                    | Complete Page Scanner<br>w/ WordScan OCR Software | 525 |
| <b>Z-NIX</b>              |                                                   |     |
| IN1003/5                  | SuperMouse II (ser) w/Win 3.0                     | 89  |
| <b>MONITORS</b>           |                                                   |     |
| <b>Various</b>            |                                                   |     |
| MT0280                    | PanaSync C1381 14" VGA Color                      | 369 |
| MT0320                    | Samtron Super VGA Color                           | 329 |

#### ENTERTAINMENT & EDUCATION

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| <b>Abracadabra</b>               |                                                          |       |
| EN2694                           | Design Your Own Home, Architecture, Interiors, Landscape | 49 ea |
| EN2684                           | Design Your Own Railroad                                 | 35    |
| <b>Broderbund</b>                |                                                          |       |
| EN0734                           | SimCity                                                  | 29    |
| ED0184                           | Where in the USA is Carmen SanDiego                      | 32    |
| <b>Centron</b>                   |                                                          |       |
| EN1073/5                         | Casino Master                                            | 39    |
| <b>Entertainment On Line</b>     |                                                          |       |
| EN2014                           | Lottery Tracker & Wheeler 4.0                            | 29    |
| <b>Microsoft</b>                 |                                                          |       |
| EN1473/5                         | *Entertainment Pack                                      | 29    |
| EN0043/5                         | *Flight Simulator 4.0                                    | 38    |
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| ED2323                           | *Excel beginning Spreadsheets                            | 65    |
| ED2423                           | *PageMaker 4.0 beginning                                 | 65    |
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| ED3023                           | *Word 2.0 beginning                                      | 65    |
| ED3173                           | *Aldus Persuasion 2.0 Beginning                          | 65    |
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| Adobe Fonts (various) | Call |

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| PR1594                       | *Adobe Type Manager                  | 59  |
| GR2094                       | *TypeAlign                           | 65  |
| GR0214                       | *Illustrator for Windows             | 309 |
| <b>Aldus</b>                 |                                      |     |
| GR0343/5                     | *Aldus FreeHand                      | 399 |
| GR5034                       | *Aldus PhotoStyler                   | 549 |
| GR2053/5                     | *PageMaker 4.0                       | 489 |
| GR5013/5                     | *Persuasion 2.0                      | 335 |
| <b>Area Software</b>         |                                      |     |
| GR3074                       | *FontMonger for Windows              | 65  |
| <b>Alsch</b>                 |                                      |     |
| GR2763/5                     | *Publisher's Powerpak for Windows    | 55  |
| GR2773/5                     | Publisher's Powerpak for WordPerfect | 55  |
| <b>Bartek Systems</b>        |                                      |     |
| GR1994                       | *After Dark for Windows              | 29  |
| <b>Broderbund</b>            |                                      |     |
| GR1564                       | New Printshop                        | 35  |
| <b>Corel Systems</b>         |                                      |     |
| GR0543/5                     | *CorelDRAW! 2.0                      | 369 |
| <b>FontBank</b>              |                                      |     |
| GR2823                       | FontBank Type Companion              | 99  |
| <b>Gold Disk Inc.</b>        |                                      |     |
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| <b>Icon Simulations</b>      |                                      |     |
| GR1854                       | *Intermission 2.0                    | 32  |
| <b>Micrografix</b>           |                                      |     |
| GR2833/5                     | *Windows Draw!                       | 105 |
| <b>Microsoft</b>             |                                      |     |
| BS2304                       | *Powerpoint for Windows              | 315 |
| GR1144                       | *Microsoft Publisher for Windows     | 129 |
| <b>New Vision Technology</b> |                                      |     |
| GR3174                       | *Presentation Task Force CGM 4.0     | 134 |
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| GR2303/5                     | Harvard Graphics 3.0                 | 415 |
| GR5063/5                     | *Harvard Graphics for Windows        | 369 |
| <b>Zsoft</b>                 |                                      |     |
| GR0634                       | PC Paintbrush IV Plus                | 119 |

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| CA0023/5                           | Design CAD 3D 3.1 | 198 |
| CA0203                             | Design CAD 2D     | 175 |
| <b>AutoDesk</b>                    |                   |     |
| CA0173/5                           | Autosketch 3.0    | 146 |
| <b>Generic Software</b>            |                   |     |
| CA0074                             | Generic CADD 5.0  | 285 |

#### BUSINESS

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| UT1294                              | SuperStor                  | 85  |
| <b>Artworx</b>                      |                            |     |
| BS4094                              | Graftek                    | 85  |
| <b>Ashton Tate</b>                  |                            |     |
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| <b>AutoMap, Inc.</b>                |                            |     |
| BS5224                              | AutoMap                    | 50  |
| <b>Borland International</b>        |                            |     |
| BS0214                              | Paradox 3.5                | 519 |
| BS3044                              | Quattro Pro 3.0            | 319 |
| <b>Campbell Services, Inc.</b>      |                            |     |
| BS3384                              | *OnTime for Windows        | 75  |
| BS2854                              | OnTime                     | 45  |
| <b>Central Point Software</b>       |                            |     |
| UT12064                             | Central Point Anti-Virus   | 85  |
| UT12133/5                           | *PC Tools 7.1              | 119 |
| <b>Chipsort</b>                     |                            |     |
| TX0304                              | TurboTax 9.0 for DOS       | 49  |
| <b>Computer Associates</b>          |                            |     |
| BS5543                              | dBast                      | 349 |
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| BN00114                             | Dac Easy Accounting 4.2    | 95  |
| BN00024                             | Dac Easy Bonus Pak 4.2     | 129 |
| BN00034                             | Dac Easy Light             | 40  |
| <b>Datasorm Tech.</b>               |                            |     |
| CM0424                              | PROCOMM PLUS 2.01          | 65  |
| <b>DCA/Crossstalk Communication</b> |                            |     |
| CM0194                              | *Crosstalk for Windows     | 129 |
| CM0284                              | Crosstalk Communicator     | 45  |
| CM00034                             | Crosstalk Mk4 2.0          | 150 |
| <b>Delrina Technology</b>           |                            |     |
| BS2604                              | *PerFORM PRO 3.0           | 185 |
| FX0154                              | *WinFax Pro 2.0            | 75  |
| <b>Fifth Generation</b>             |                            |     |
| UT0724                              | Direct Access 5.1          | 65  |
| UT1184                              | Fastback Plus 3.0          | 125 |
| <b>Fox Software</b>                 |                            |     |
| BS0705                              | Fontbase + Dev System 2.10 | 189 |
| BS4065                              | FontPro 2.0                | 485 |
| <b>Gibson Research</b>              |                            |     |
| UT0874                              | Spinrite II 2.0            | 65  |
| <b>Helix</b>                        |                            |     |
| BS3154                              | *NetRoom Single User 2.0   | 59  |

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| <b>Inset Systems</b>             |                                           |      |
| UT1614                           | Hijaak 2.1                                | 99   |
| <b>Intuit</b>                    |                                           |      |
| FN0164                           | Quicken 5.0                               | 43   |
| FN0564                           | *Quicken for Windows                      | 35   |
| <b>Lotus</b>                     |                                           |      |
| BS4204                           | All Lotus Upgrades                        | Call |
| BS5203/5                         | Ami Pro 2.0                               | 299  |
| BS4073/5                         | Lotus 1-2-3 3.1 Plus                      | 419  |
| BS5253/5                         | Lotus 1-2-3 Rel. 2.3                      | 339  |
| BS3973                           | *Lotus 1-2-3 for Windows                  | 339  |
| BS3973                           | Lotus Graph Writer II                     | 399  |
| <b>Microcom</b>                  |                                           |      |
| CM0574                           | *Carbon Copy for Windows                  | 119  |
| CM0084                           | Carbon Copy Plus 6.0                      | 115  |
| <b>Microsoft</b>                 |                                           |      |
| OP0113/5                         | DOS 5.0 Upgrade                           | 59   |
| BS3254                           | *Excel for Windows 3.0                    | 309  |
| FN0464                           | *Microsoft Money for Windows              | 45   |
| BS4103/5                         | *Office for Windows                       | 485  |
| BS2733/5                         | *Productivity Pack                        | 39   |
| BS7004                           | *Project for Windows 1.0                  | 445  |
| BS2253/5                         | *Windows 3.0                              | 315  |
| BS1954                           | *Windows Developer's Tool Kit             | 919  |
| WP0043/5                         | Word 5.5                                  | 209  |
| WP0374                           | *Word for Windows 2.0                     | 299  |
| BS5324                           | *Microsoft Works for Windows              | 129  |
| BS0173/5                         | Works 2.0                                 | 95   |
| <b>Multisoft Corporation</b>     |                                           |      |
| UT0554                           | PC-Kwik Power Pak 2.1                     | 75   |
| UT0543/5                         | Super PC - Kwik 4.1                       | 45   |
| <b>Norton-Lambert</b>            |                                           |      |
| CM0503/5                         | *Close-Up 4.0 /Windows & DOS              | 119  |
| <b>Onna Corporation</b>          |                                           |      |
| BS1124                           | *The Desktop Set 3.0                      | 79   |
| <b>PC Globe, Inc.</b>            |                                           |      |
| BS1834                           | PC Globe 4.0                              | 37   |
| BS1844                           | PC USA 2.0                                | 35   |
| <b>Peachtree Software</b>        |                                           |      |
| FN0233/5                         | Peachtree Complete III 5.0                | 145  |
| <b>Polaris</b>                   |                                           |      |
| BS2894                           | *PackRat 4.0                              | 259  |
| <b>Power Up Software</b>         |                                           |      |
| BS1654                           | Calendar Creator Plus 4.0                 | 49   |
| <b>Qualitas</b>                  |                                           |      |
| UT0684                           | 386MAX 6                                  | 65   |
| <b>Quarterdeck Office System</b> |                                           |      |
| BS1043/5                         | DEServe 386 2.4                           | 129  |
| EX1103/5                         | QEMM 386 6.0                              | 61   |
| <b>Que Software</b>              |                                           |      |
| WP0544                           | RightWriter 4.0                           | 52   |
| <b>Reference Software</b>        |                                           |      |
| WP0514                           | *Grammatik Windows                        | 55   |
| <b>Softstream</b>                |                                           |      |
| TX0224                           | TaxTutor Plus                             | 62   |
| BN0210                           | TaxTutor Plus/TurboTax 9.0 for DOS Bundle | 99   |
| <b>Spinnaker Software</b>        |                                           |      |
| BS1923/5                         | BetterWorking Eight-In-One                | 32   |
| BS3604                           | *PFS Window Works                         | 125  |
| <b>Symantec</b>                  |                                           |      |
| UT1223/5                         | Norton AntiVirus 2.0                      | 85   |
| UT1833/5                         | *Norton Desktop for Windows               | 99   |
| UT0054                           | Norton Util. Advanced 6.01                | 115  |
| UT1213                           | *Norton Backup Windows/DOS                | 85   |
| CM0173/5                         | PC Anywhere 4.5 Host and Remote           | 119  |
| BS4013/5                         | Q&A 4.0                                   | 255  |
| BS3723/5                         | *On Target 1.0                            | 255  |
| <b>Teleware</b>                  |                                           |      |
| FN0414                           | *M Y O B for Windows                      | 135  |
| <b>Timeslips</b>                 |                                           |      |
| BS0133/5                         | Timeslips III 4.0                         | 189  |
| <b>Traveling Software</b>        |                                           |      |
| UT0714                           | Leptik Pro                                | 109  |
| <b>WordPerfect Corp.</b>         |                                           |      |
| WP0363/5                         | WordPerfect 5.1                           | 249  |
| WP1653/5                         | *WordPerfect 5.1 for Windows              | 295  |
| <b>WordStar U.S.A.</b>           |                                           |      |
| WP1604                           | *Correct Grammar for Windows              | 65   |
| WP1614                           | *WordStar for Windows                     | 279  |
| <b>XTree Company</b>             |                                           |      |
| UT1874                           | XTree Gold 2.5                            | 99   |

#### LANGUAGES

|                        |                           |      |                              |                            |    |
|------------------------|---------------------------|------|------------------------------|----------------------------|----|
| UT0724                 | Direct Access 5           | 65   | <b>Borland International</b> |                            |    |
| UT0718                 | Fastback Plus 3.0         | 125. | LN1654                       | Borland C++ 2.0 Prof       | 32 |
| <b>Fox Software</b>    |                           |      | LN1664                       | *Object Vision for Windows | 10 |
| BS0705                 | Foxbase + Dev System 2.10 | 189  | LN1673                       | Turbo C++ 2nd Edition 1.0  | 6  |
| BS4065                 | FoxPro 2.0                | 465  | LN0463/5                     | Turbo C++ for Windows      | 11 |
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| UT0874                 | Spinrite II 2.0           |      | LN0085                       | QuickBasic 4.5             | 65 |
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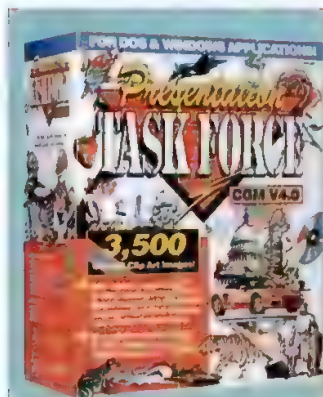
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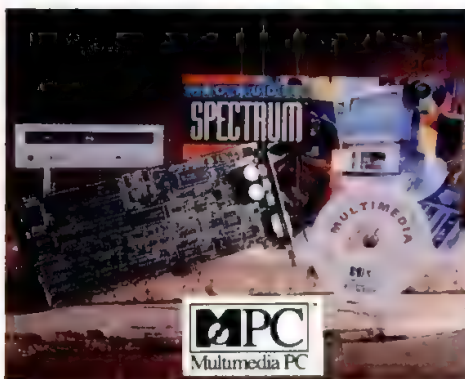
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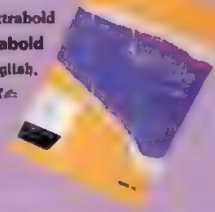
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by  
Joe Salemi

# Advisor

## LONG-DISTANCE FILE TRANSFERS

The company I work for has offices in California and Hong Kong that routinely exchange files. The California office maintains a bulletin board so the Hong Kong office can upload files it needs to send or download files put there by the California office. Each office has a 2,400-bit-per-second modem with MNP 5, and the files are sent using the Xmodem file-transfer protocol. The transfer works, but the connection is occasionally terminated in the middle of a transfer. Should we chalk this problem up to distance and noise on the telephone line, or is there something we can do to make the procedure run more smoothly?

J. Miller  
Irvine, California



Distance could be a factor; it's likely that the phone calls are going through a satellite, which introduces delays in the signal that may cause one end to think that the other has hung up so the first modem terminates the call. MNP will attempt to control any errors that are introduced by line noise, but it will give up after a while if there are more errors than it can cope with.

Probably your best solution is to replace Xmodem with a transfer protocol designed to handle the problems and delays introduced by satellite and packet-switching networks. The best overall choice is Zmodem, a streaming protocol that's less sensitive than Xmodem to glitches on the phone lines.

More importantly, Zmodem is able to save partially transferred files and resume the transfer from where it left off; with Xmodem, you have to restart the transfer from the beginning of the file. The cost savings are obvious, particularly on long-distance calls.

If your BBS or communications programs don't have built-in Zmodem support, you can add an external driver that your program can shell to. The best driver

■ **LONG-DISTANCE FILE TRANSFERS:** Is there a better protocol than Xmodem for bridging long distances?

■ **HIGH-SPEED FAX AND MODEM:** Fax/modem combinations that support the V.32 standard.

is the shareware program *DSZ* (Omen Technology Inc., P.O. Box 4681, Portland, OR 97208; 503-621-3406 or BBS 503-621-3746; \$20 registration fee) by Chuck Forsberg, the inventor of the Zmodem protocol. This text-based driver also supports Xmodem, Ymodem, and Zmodem-90, which is the latest version of Zmodem.

Omen Technology has recently released *GSZ*, a character-based graphics version of *DSZ* that displays complete information about the progress of the transfer. *GSZ* is available for a \$30 registration fee, which also includes registration of *DSZ*. You can get either version directly from Omen Technology; the driver can also be found on various BBS systems or CompuServe (IBMCOM Forum) as *DSZ.ZIP* or *GSZ.ZIP*.

## HIGH-SPEED FAX AND MODEM

In researching fax/modem hardware, I have found that while most of these products can send and receive faxes at 9,600 bps, their data modems communicate at only 2,400 bps (or less) and don't offer the most effective data-compression and error-checking protocols. Can you direct me to a fax/modem unit with a faster modem? I am looking for data throughput in the neighborhood of 38,400 bps.

Anatole Shaw  
Great Neck, New York



What you want is a fax/modem combination that supports the V.32 standard (9,600 bps), with V.42 error control and V.42bis data compression. ATI makes the 9600ETC-FAX (ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, CA M1W 3S2; 416-756-0718; \$500), an internal ISA bus board that supports both CCITT Group 3 fax and the full V.32 standard. If you prefer an external model, there's the 9632S+ Fax/Modem (Omni-Tel Inc., 3500 W. Warren Ave., Fremont, CA 94538; 800-OMNITEL, 510-490-2202; \$948), which also supports Group 3 fax and V.32.

If you're looking for an even higher speed modem with fax support, try the 9624LE+ external (\$895) or 9624PC+ internal ISA (\$865) V.32bis modem from Digicom Systems Inc. (188 Topaz St., Milpitas, CA 95035; 408-262-1277). V.32bis, the new CCITT standard for 14,400-bps communications, is backward-compatible with V.32 and includes V.42/V.42bis. This modem is one of the V.32bis models that was reviewed in the March 17, 1992, issue.

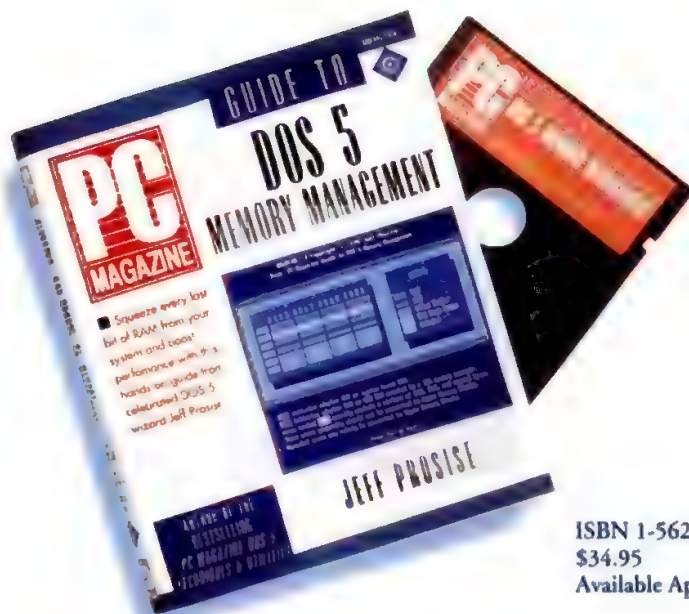
Practical Peripherals (31245 La Baya Dr., Westlake Village, CA 91362; 818-991-8200) announced a V.32bis modem with Group 3 fax support at Fall Comdex 1991, with a scheduled release date sometime in late 1991/early 1992. Unfortunately, no pricing information was available at the time of this writing.

I expect that many more high-speed fax/modems will be released in 1992 as vendors of existing 2,400-bps combinations upgrade to support the V.32 and V.32bis standards.

## ASK THE ADVISOR

Send your question to Advisor, One Park Avenue, New York, NY 10016, MCI mailbox PC MAGAZINE, or upload it to PC MagNet (see the instructions for joining on page 10 of this issue). We regret that we can't acknowledge submissions or answer letters individually. ■





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by  
Jeff Prorise

# Tutor

## OUTSIDE HELP

DOS 5.0's HELP command may be useful to some people, but I've been using my own utility for some time now and prefer it. Is there a way to disable the DOS HELP facility so that when I type HELP, mine executes?

Richard M. Brown  
Champaign, Illinois



There sure is—several, in fact. One way is to rename the HELP.EXE file that the DOS 5.0 setup routine placed in your hard disk's DOS directory. Call it DOSHELP.EXE or something like that, then—when you type HELP—your own program will execute. If you want to run DOS 5.0's HELP, type DOSHELP.

Another way is to modify your PATH so the directory containing your HELP program comes before the one holding the DOS HELP program. DOS searches directories according to their order on your PATH, so—assuming there are identically named commands—the one stored in the earlier directory will execute. The only time this won't work is when you're in the DOS directory. Since the operating system searches the current directory before the ones in your PATH, programs in it get priority.

The two techniques above are valid only if you're replacing an external DOS command. Perhaps the best method is to define a DOSKEY macro—giving it the alias name HELP—that runs your program. This approach functions with both internal and external commands. DOSKEY aliases work identically to internal commands and take precedence over DOS commands of the same name. If your HELP program is stored in the \UTIL directory of drive C: and called HELP.COM, for example, type

**DOSKEY HELP=C:\UTIL\HELP**

Now, when you type HELP, HELP.COM will execute, not DOS's HELP.EXE. The

- **OUTSIDE HELP:** Three methods for replacing the DOS HELP command with your own.
- **EMM386 AND WINDOWS:** Some methods for calming the battle between Windows' Standard mode and EMM386.EXE.

beauty of this is that you can still run the original by typing a space in front of HELP.

These techniques for substituting user commands for DOS commands aren't unique to HELP. You can use them to replace any DOS command.

## EMM386 AND WINDOWS

I implemented your suggestions for optimizing memory use under DOS 5.0, which appeared in the September 24, 1991, Tutor column. Specifically, I installed EMM386.EXE in order to load TSRs and device drivers high and make expanded memory available to my applications. Now, however, when I try to start Windows 3.0 in Standard mode, I get the message "Cannot run Windows in standard mode. Check to ensure you are not running protected mode software, or run in real mode." What am I doing wrong?

Terence So  
Hong Kong



You're not doing anything wrong. In Standard mode, Windows 3.0 is incompatible with DOS 5.0's EMM386.EXE driver (the "protected mode" software Windows was referring to in its message), so it won't allow itself to be started. This leaves you with four options:

- Switch to Real or 386 Enhanced mode,

which are both compatible with EMM386. You obviously use a 386- or 486-based PC or you wouldn't be able to load it at all. If you have at least 640K of conventional memory and 1MB of extended, Windows (on a 386 or better) kicks into Enhanced mode automatically. If you have 640K of conventional memory and at least 384K of extended, you can force Enhanced operation with a /3 switch. To really take advantage of Enhanced mode, you should have at least 2MB of RAM. 4MB is better still.

- Use a third-party 386 memory manager that is compatible with Windows' Standard mode to replace EMM386. QEMM-386 fills the bill nicely.

- Unload EMM386 before running Windows. The easiest way is to maintain multiple configuration files and boot up your machine without the memory manager in your CONFIG.SYS when you're going to run Windows. The December 17, 1991, Tutor column explained one method in detail and provided a short utility you can use to implement it.

- Wait for Windows 3.1, whose Standard mode will with any luck be compatible with EMM386. At the time I'm writing this column, it is too early to tell.

The best option of the four is adding enough memory to run in Enhanced mode. If you use Windows regularly, you'll benefit from the extra memory. And the features you'll gain, such as the ability to run multiple DOS apps—and in resizable windows rather than full-screen—will make the effort well worthwhile. With memory currently going for less than \$100 per megabyte, now is a great time to upgrade your system for the future.

## ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. Send your question to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016. ■



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by  
Neil J. Rubenking

# User-to-User

## A BETTER WAY TO MOVE

The 2.BAT routine in the June 25, 1991, User-to-User column is great, but a little modification makes it even better (see Figure 1). I almost always use the batch file instead of the CD command, but got frustrated each time the original returned me to the root directory when I meant to go to a subdirectory. The new version takes care of that!

Jorn B. Zinglensen  
Roskilde, Denmark



This simple change renders 2.BAT *much* more useful! The original 2.BAT made directory changing quicker by eliminating the need for the

■ **A BETTER WAY TO MOVE:** Speed your travel between directories even more with a new version of a good routine.

awkward colon and backslash keys, but it required you to enter the full destination path. You could go to C:\FOO\BAR with the command 2 C FOO BAR, but to go from there to C:\FOO\BAR\TEMP required you to type 2 FOO BAR TEMP. The improved version checks whether

the first directory specified resides in the current directory, switching to the root only if that is *not* the case. The key to this improvement is the line

```
IF NOT EXIST %1\NUL CD \
```

The NUL device always exists; the only way this test can fail is if the specified *directory* does not exist. In that case it moves to the root directory.

There's potential for confusion if the current directory and the root directory both contain subdirectories of the same name, for instance TEMP. The command 2 TEMP will always go to the TEMP subdirectory of the current directory, if there is one. If that's not what you wanted, just insert a backslash: 2 \ TEMP will take you to the TEMP subdirectory below the root.

Another possible slip can result when a subdirectory has a single-letter name that's the same as an existing drive letter. The original 2.BAT required you to avoid such names in the root directory; the new one extends this requirement throughout the directory tree. The command 2 D will take you to the current directory on the D: drive even if a directory called D exists in the current drive. If you really want to use 2.BAT to go to such a directory, use the command 2 . D.

Figure 2 lists several commands and their effects in the old and new versions of 2.BAT. As with the previous version, adjust the FOR lines in the batch file so they include only the drive letters that are active on your system.

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### 2.BAT ————— COMPLETE LISTING

```
@ECHO OFF
FOR %h IN (a A b B c C d D e E) DO IF (%1) == (%h) %h:
REM FOR %h IN (f F g G) DO IF (%1) == (%h) %h:
FOR %h IN (a A b B c C d D e E) DO IF (%1) == (%h) SHIFT
REM FOR %h IN (f F g G) DO IF (%1) == (%h) SHIFT
IF NOT EXIST %1\NUL CD \
FOR %f IN (%1 %2 %3 %4 %5 %6 %7 %8 %9) DO CD %f
```



Figure 1: A simple change lets 2.BAT speed your interdirectory travel even more.

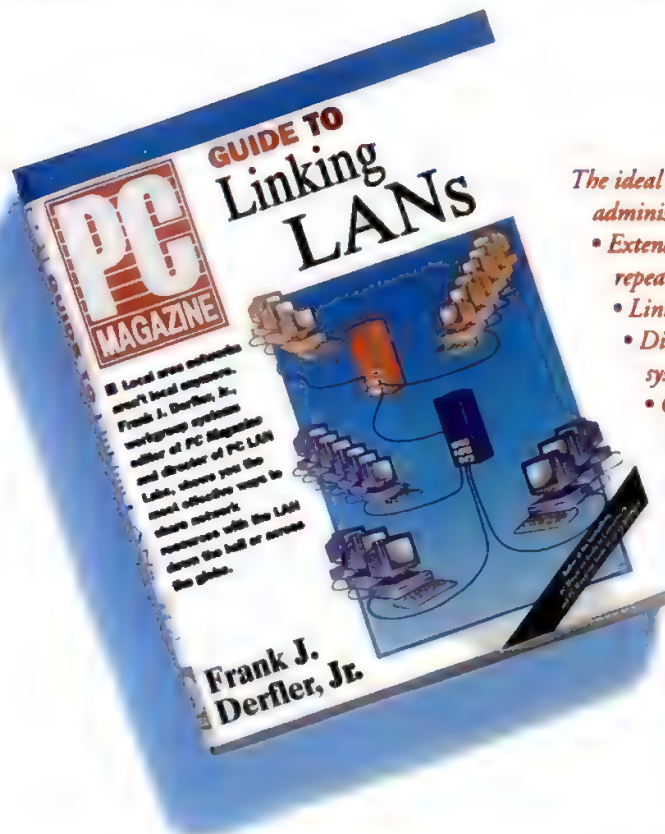
### 2.BAT: OLD VERSUS NEW

| Command | Old version                                                                  | New version                                                                                                                  |
|---------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 2 .     | Goes to the root directory of the current drive                              | Stays in current directory, like "CD ."                                                                                      |
| 2 ..    | Goes to the root directory of the current drive, reports "Invalid directory" | Goes to the parent of the then current directory, like "CD .."                                                               |
| 2 D     | Goes to the root directory of D:                                             | Goes to the D directory in the current directory if it exists; goes to the current directory of D: otherwise                 |
| 2 TEMP  | Goes to the TEMP directory in the root directory                             | Goes to the TEMP directory in the current directory if it exists; goes to the TEMP directory in the root directory otherwise |

Figure 2: This table lists several commands and the different response of each version.



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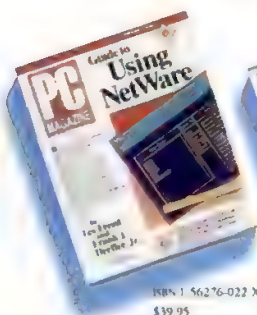
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by  
Fran Finnegan

# Windows

## DOS VS. WINDOWS VS. OS/2

Everything I've read in the major computer magazines says that Windows runs on top of DOS and is therefore restricted by it, while OS/2 is not. When I ask people about Windows and OS/2, most of them say that if OS/2 2.0 does what IBM says it will, then they'll definitely switch to it; they also note that DOS constrains Windows to being a 16-bit environment, compared with OS/2 2.0, which is a more-powerful, 32-bit operating system. But then I see debates on CompuServe about whether or not DOS really does restrict Windows. One person says yes, it does; another says it doesn't. It gets kind of confusing—as if the Windows-versus-OS/2 debate weren't confusing enough.

Mike Davis

Wixom, Michigan



Sometimes you need to step back and look at the big picture. Consider the basic components that make up your computer system: a microprocessor, memory, a keyboard/mouse/pen, a monitor/panel, input/output (I/O) ports, disks/files, an operating system with device drivers, and application software. DOS usually controls all of the hardware under it and software on top of it. However, when Windows is running in protected mode (as it does in both Standard and 386 Enhanced modes), it takes over almost all of DOS's duties. Windows manages memory, the keyboard/mouse/pen, the monitor/panel, the I/O ports, and Windows device drivers and applications. It hands over the microprocessor to DOS only for normal disk/file access and for running non-Windows device drivers.

Except for these two areas, Windows becomes the operating system. When you aren't doing disk/file access or using a non-Windows device driver (probably most of the time), DOS isn't being executed at all. For 386 Enhanced mode DOS shells, Windows *virtualizes* DOS, meaning that it runs multiple copies of DOS, where each copy is unaware of the other

■ DOS VS. WINDOWS VS. OS/2: Does DOS really restrict Windows? Is Windows really inferior to OS/2?

copies and of Windows and therefore thinks that it has complete control over the hardware, when it really doesn't. It does this by using special hardware features of the 80386-or-better microprocessor to run the DOS shell in Virtual 86 mode. With this technique, the virtual copy of DOS doesn't directly access any hardware. Standard-mode DOS shells, however, are actually executing native DOS.

DOS does restrict Windows in a minor way in each of the areas mentioned. The restrictions result from DOS's being written in single-threaded (and thus non-reentrant) code. This means that once Windows or an application calls DOS for disk/file access or to access a DOS device driver, DOS cannot handle another call until it finishes the first one; otherwise, DOS may get corrupted. But in 386 Enhanced mode with DOS sessions running in the Virtual 86 mode of the 80386/80486, Windows prevents a DOS session from directly accessing any hardware. When one DOS session attempts to access the hardware, Windows preempts it until any previous DOS call from a different session is completed. Then the real DOS call for the interrupted session can be carried out by Windows. That is what allows multiple DOS sessions to run.

DOS does *not* restrict Windows to being a 16-bit operating system. Windows itself, in its current incarnation, was designed almost a decade ago to be a 16-bit operating system; parts of it are now capable of 32-bit operation. The Windows API is currently 16-bit, as is DOS's, but Windows device drivers can be writ-

ten as native 32-bit code (for 386 Enhanced mode).

A future version of the environment (Windows NT, for New Technology) is being developed as a pure 32-bit system, with a 32-bit API. It will replace DOS and be backward-compatible with current 16-bit Windows applications.

The real question is, Does Windows' reliance on DOS for the two areas noted really restrict you in what you can do with your computer? The answer is that it depends on your individual circumstances.

Will OS/2 2.0 be "a better DOS than DOS" and "a better Windows than Windows"? Somehow, I doubt it. Who really cares if you can run different versions of DOS concurrently in different OS/2 Presentation Manager windows on the same machine? Is Windows better if you can run multiple copies of it concurrently under OS/2 2.0? If IBM is licensing the Windows source code from Microsoft to include it in OS/2, can they be modifying it in ways that Microsoft hasn't already thought about to make it significantly better, enough so as to switch to it? And haven't you noticed that a lot of the neat things about OS/2, such as protected memory and fault (UAE) trapping, are showing up in Windows? Sounds like just a lot of IBM marketing money to me.

But even if OS/2 2.0 someday acquires the plethora of device drivers and applications that DOS and Windows have today, the vast majority of users will still not be able to see any functional difference between the two. So, for most people, DOS hardly places any restriction on Windows. After all, it's not exactly the same kind of restriction as having only 512K of memory or a 10MB hard disk.

## OPENING WINDOWS

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by  
M. David Stone

# The Working Word

## DIRECTORY MENUS IN WORDPERFECT

If you organize your *WordPerfect* data files in directories based on logical categories, using the List command (F5) can be a cumbersome way to move among these directories. Figure 1 shows a sample macro that creates a pop-up menu of sub-directories and lets you switch to any of them in one keystroke. If you attach the menu macro itself to a single-key combination such as Alt-D for Directory, then the whole process of calling up the macro and changing directories takes just two keystrokes. The example shows only two choices, for the Dissertation and Personal directories, but you can add as many as you need.

The {^P} is a placement code that designates the starting point for each line of the menu. Immediately following the {^P} code are the coordinates for the first character in that line (in this case, the first character of each line is a vertical line that forms the left side of the menu box). The format for the code is

```
{^P}ColumnRow
```

The column and row are entered as ASCII codes. For example, the left-pointing arrow in each line is the DOS symbol for ASCII 27, and designates column 27. The next character designates the row, using ASCII 1 to ASCII 8. In each case, you enter the characters by holding down the Alt key, entering the appropriate number with the numeric keypad, and then releasing the Alt key. The lines that form the box are also ASCII characters and are entered the same way.

The {^} and {^} in the first section of the macro enclose characters that will appear in boldface on-screen. As you can see in the figure, these codes will throw off the alignment in the Macro Editor, so it's generally best to add these highlight codes after you've otherwise completed the menu design. The shaded area on the bottom row consists of ASCII character 178s; it's

■ **DIRECTORY MENUS IN WORDPERFECT:**  
Building menus and moving to directories in *WordPerfect* 5.0 and 5.1.

simply filler to mark the space in case you want to add more directory items later.

You can also use this menu-building template as a way to call up other macros, as in Figure 2. Creating this sort of menu lets you automate functions without making you remember the names or key combinations for each macro.

John Rogers  
Pittsburgh, Pennsylvania



This tip deals with four entirely separate issues: changing directories, building attractive menus, giving commands with menus, and building what amount to two-key macros. Each of these deserves a discussion of its own. I'll start with changing directories.

Building a menu that changes directories is a good choice if you rarely change your directory structure. However, if you are constantly adding new directories as you start new projects, you might find that rebuilding the menu each time becomes a chore. The technique I've always preferred is to create an individual macro for each directory and name the macro after the directory.

For example, my *PC Magazine* data directory is \DATA\PC, and the macro to get there is named PC. In *WordPerfect* 5.1, each macro would take the form

```
{List}C:\DATA\PROJECT{Enter}
```

(For Version 5.0 replace {List} with {List Files}.)

This is equivalent to typing F5 to ask for a directory list, typing the directory name to change to, and then pressing

Enter to move to that directory. Notice that this one-line macro is identical to the commands in Figure 1 that take you to the appropriate directories. In either case, you can retrieve, delete, or otherwise manage the files in the specified directory, but the default directory remains unchanged.

If you prefer, you can designate the specified directory as the new default by using the alternative form

```
{List}=C:\DATA\PROJECT{Enter}{Enter}
```

in both the one-line macros and the macro shown in Figure 1. This is equivalent to typing F5 to ask for a directory list, specifying a new default directory with the equal sign, pressing Enter once to enter the new default, and pressing Enter a second time to see a list of the files in the new default directory.

Regardless of whether you prefer to change to a specified directory temporarily or make it the new default, there are two important differences between using the approach shown in Figure 1 and using the one-line alternatives—one in running the macros, and one in creating them.

To run a macro like the one in Figure 1, you need only remember one macro name. In fact, it makes good sense to attach the macro to an Alt-key combination, such as Alt-D for Directory, since you'll probably use it often enough to make it easy to remember.

To run a separate macro, you must give the Macro command, Alt-F10, then enter the macro name. Of course, you could attach each macro to an Alt-key combination, but then you'd have to remember each key. And the real beauty of naming each macro after the directory it takes you to is that if you know the directory you want to go to, you automatically know the macro name as well.

The difference in how you create the macros for the two approaches is far more significant. With separate macros for each directory, you can easily create each macro on the fly by typing Ctrl-F10 to define the



```
ALTD WPM                                     COMPLETE LISTING
```

{ON CANCEL}{GO}cancel~

{CHAR}1~  
{^P)+O  
{^P)+@ .....{^}]DIRECTORY(^\\}.....|  
{^P)+v .....|  
{^P)+d .....{^}]D(^\\)issertation...|  
{^P)++ .....{^}]P(^\\)ersonal.....|  
{^P)+A .....|  
{^P)+e .....|  
PC MAGNET  
-  
{^P)+[

{DISPLAY OFF}{DISPLAY ON}  
{CASE}{VAR 1}-  
d~dissertation~  
D~dissertation~  
p~personal~  
P~personal~  
-

{QUIT}

{;} These are samples only. Be sure to substitute your own directory names and modify the menu appropriately~

{LABEL}dissertation~  
{List)c:\data\dissert{Enter}  
{QUIT}

{LABEL}personal~  
{List)c:\data\personal{Enter}  
{QUIT}

{LABEL}cancel~  
{DISPLAY OFF}{DISPLAY ON}{QUIT}

**Figure 1:** This *WordPerfect* macro creates a pop-up menu that lets you switch to another subdirectory.

macro, optionally adding a description, giving the commands to move to the directory, and, finally, with the directory list on your screen, typing Ctrl-F10 to end the recording. With the menu-based directory macro, you must enter the menu changes and commands in the Macro Editor. And that makes the menu approach less desirable if your directory structure changes often.

Completely divorced from the question of changing directories is the issue of building attractive menus in your macros. The menus in Figures 1 and 2 are admirable models to follow. Despite looking somewhat askew in the figures, the result on-screen has a professional look.

There are a couple of points to be aware of when building a menu this way. First, because you must designate a specific row and column for each line in the menu, and because the specifications as they show on-screen are somewhat arcane, you have to be careful to enter the right ASCII characters. Otherwise, you may wind up with gaps in the table or with one line overwriting another.

Second, note that the box around the menu items is formed from individual line-drawing characters. In this particular

example, the ASCII codes for the characters are

|       |       |
|-------|-------|
| 179   | 196 - |
| 191 7 | 192 L |
| 218 厂 | 217 丿 |
| 180 4 | 195 卜 |

There are other sets of characters that give you double lines instead, with ASCII values between 179 and 218.

You can't use *WordPerfect's* Line Draw feature to build these boxes directly, because Line Draw does not work within the Macro Editor. However, if you like, you can use the Line Draw feature to create all or part of the box in the standard editing screen, even adding the text inside the box. You can then insert the box into the Macro Editor in pieces of up to 128 characters (including spaces between vertical lines), by defining blocks and assigning those blocks to variables.

Start by creating the box (or any part of it) in the editing screen. Next, turn on *WordPerfect's* Block feature with Alt-F4 and define an appropriate block (up to 128 characters, including spaces or text inside the box). With the block still defined, press Ctrl-PgUp and assign the block to a variable by typing any one numeral, then Enter. You can define up to 10 variables this way (using the numerals 0 through 9), which means you can store up to 1,280 characters at once. That should be more than enough for most menus.

For purposes of this example, I'll assume you've assigned the first block to variable 1, the second to variable 2, and so on. Once you've defined the variables, you can insert the pieces of the box into the Macro Editor by pressing Alt-1 to insert the first block, Alt-2 to insert the second block, and so forth. Note that this technique will not copy the commands that boldface the characters, so you'll have to add

the boldfacing commands manually in the Macro Editor.

Also note the tilde (~) at the end of the menu. The {CHAR} command takes the form

```
{CHAR}var~message~
```

In this case, the entire menu is the message, so be sure to end it with the tilde. The next command line, {DISPLAY OFF}{DISPLAY ON}, may seem unnecessary, but if you don't add it, *WordPerfect* won't refresh the screen to remove the menu when you exit the macro by pressing the wrong key.

As always with the *WordPerfect* Macro Editor, you enter the items in curly brackets by typing the appropriate function-key and Ctrl-key commands (such as F5 for {List} or Ctrl-] for {^})), preceding the keystroke with Ctrl-V for commands that otherwise work within the Macro Editor

```

{ON CANCEL}{GO}cancel~
{CHAR}1~
(^P)+O ... {^}}Punctuation·MACROS{^}\·· |
(^P)+V ... {^}}C{^}\}lose·Quotation·Mark· |
(^P)+A ... {^}}O{^}\}pen·Quotation·Mark·· |
(^P)+A ... {^}}M{^}\}-Dash·············· |
(^P)+A ... {^}}N{^}\}-Dash·············· |
(^P)+Q ~
{DISPLAY OFF}{DISPLAY ON}
{CASE}{VAR 1}~
c~close~
C~close~
o~open~
O~Open~
m~emdash~
M~emdash~
n~endash~
N~endash~
~
{QUIT}
{} These are samples only. Be sure to
substitute actual macro names that exist
on disk and modify the menu appropriately~
{LABEL}close~
{CHAIN}quotel~
{GO}end~
{LABEL}open~
{CHAIN}quote2~
{GO}end~
{LABEL}emdash~
{CHAIN}emdash~
{GO}end~
{LABEL}endash~
{CHAIN}endash~
{GO}end~
{LABEL}cancel~
{DISPLAY OFF}{DISPLAY ON}{QUIT}
{LABEL}end~

```

**Figure 2:** This *WordPerfect* macro demonstrates how to create a menu that invokes other macros.



(such as {Enter}), and typing Ctrl-PgUp and then picking from the command list macro commands such as {CHAR}. (If entered correctly, all these commands will show in boldface on your screen.)

The rest of the macro in Figure 1 consists of a straightforward example of using the CASE statement to evaluate and then act on the response to the menu. It first tests to see what key was typed. If it isn't one of the expected keys, the macro continues to the {QUIT} line and quits. If it is one of the defined keys, the macro jumps to the appropriate label, changes to the requested directory, and then quits. Note the further {DISPLAY OFF} {DISPLAY ON} commands after the Cancel label. Without these, the screen will not rewrite properly if you give *WordPerfect's* Cancel command (F1).

The difference between the macros in Figure 1 and Figure 2 is not what they do, but how they do it. The macro in Figure 1 includes the commands for each menu item as part of the macro. This is an appropriate approach in this case, because the set of commands for each menu item is short, and isn't likely to change.

The macro in Figure 2 uses the Chain

command to invoke other macros. The longer and more complex the commands for each menu item, the more appropriate this approach. This approach also lets you attach Alt-key combinations to some or all of the chained macros, so you can call them up directly in addition to invoking them through the menu-based macro.

If you compare the two figures, you'll also see a slight difference in the mechanics of creating the two. In Figure 1, the macro flows from the Case statement to the appropriate label to the command to change directory to a {QUIT} command. In Figure 2, the {QUIT} commands are replaced by {GO} commands that jump to the end of the macro. The {GO} commands are required in Figure 2 because the {CHAIN} command specifies the name of a macro to chain to *after* the current macro. If you end the current macro with a {QUIT} command, macro execution stops entirely. However, you could replace the {QUIT} commands in Figure 1 with the {GO} commands and End Label of Figure 2.

Finally, note that creating menus this

way lets you group sets of macros together. The result is functionally equivalent to letting you assign two keys to each macro, so that you can use easily remembered mnemonics for your macro keys rather than arbitrary key assignments. For example, you could assign all printing-related macros to a single Print menu modeled on the macro in Figure 2, and assign the menu macro to Alt-P. Choices on the menu might include P for print page, S for print selected block, and so on. You could even have a macro with menu choices that call up other macros containing menu choices, thus creating your own menu tree structure.

#### TIPS FROM WORKING WORDSMITHS

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by  
Craig Stinson

# Spreadsheets

## AN EXCEL TIME-AND-DATE MACRO

While working in *Microsoft Excel*, I often need to know the time and date. I have to paste time/date stamps on revisions several times a day. The macro in Figures 1 and 2 addresses both problems.

When the macro is opened, it automatically inserts a Time menu on the main menu bar. Clicking on the word Time (or pressing Alt-I) displays the current system time and date (see Figure 3). Clicking on the time or date inserts it into the current spreadsheet cell. As far as I know, this is the simplest and quickest way of finding the date and time and adding them to your worksheet.

Dale Arndt  
Weston, Ontario, Canada

**PC** Mr. Arndt's clever time-and-date stamper is proof positive that *Excel*'s menu-customizing features can be helpful for everyday work, not just for professional application developers. It also shows how easy these features are to use.

The macro is named `Auto_Open` so that it executes automatically when the macro sheet is opened. The first statement

```
=ADD.MENU(1,TimeMenu,9)
```

tells *Excel* to put a new menu in position 9 of menu bar 1 and to find a description of the new menu in the range named `TimeMenu`. Menu bar 1 is the full-menu version of the worksheet menu bar, and position 9 means just to the left of the ninth menu on that menu bar. Assuming the menu bar hasn't been changed in any other way, the ninth menu is Help, so Mr. Arndt's Time menu will appear near the right edge of the menu bar, between Window and Help.

The range named `TimeMenu` extends from C2 to D4 (see Figure 2). The labels above and to the right of this range are for documentation only; they are disregarded by *Excel* and must not be included in the

■ AN EXCEL TIME-AND-DATE MACRO: A convenient way to display the time or date and insert it into your worksheet.

second argument of the `ADD.MENU` function.

The upper-left corner of the `TimeMenu` range provides the name of the new menu—`T&ime`. The ampersand before the letter *i* makes that letter a hotkey for keyboard access. The two cells directly below the corner cell—C3 and C4—supply the names of the Time menu's commands. Because they're blank on Mr. Arndt's macro sheet, the new Time menu actually has two unnamed commands—but only for an instant. It's customary to supply names for your new menu commands (and Mr. Arndt's macro will do that in a moment), but in fact

blank commands are permitted.

The second column of the `TimeMenu` range tells *Excel* what to do when each of the new menu's commands is chosen. If the user selects the first command, *Excel* executes the macro named `TIME-DATE.XLM!PasteTime`. If the second command is chosen, the macro named `TIMEDATE.XLM!PasteDate` is executed. Note that both macro references must include the name of the macro sheet on which they reside. (If you re-create Mr. Arndt's time/date stamper on your own system, modify these references accordingly.) We'll look at the `PasteTime` and `PasteDate` macros in a moment.

The second statement in the main macro

```
=RUN(DisplayTime)
```

calls the subroutine located at the cell named `DisplayTime`. This subroutine's job is first to change the names of the Time menu's commands from blanks to the current time and date and then to update the menu names once a minute.

| TIMEDATE.XLM |                                                                                               | PARTIAL LISTING |
|--------------|-----------------------------------------------------------------------------------------------|-----------------|
|              | A                                                                                             |                 |
| 1            | Auto_Open                                                                                     |                 |
| 2            | =ADD.MENU(1,TimeMenu,9)                                                                       |                 |
| 3            | =RUN(DisplayTime)                                                                             |                 |
| 4            | =RETURN()                                                                                     |                 |
| 5            |                                                                                               |                 |
| 6            | DisplayTime                                                                                   |                 |
| 7            | =RENAME.COMMAND(1,"Time",1,TEXT(TIME(HOUR(NOW()),MINUTE(NOW()),),"hh:mm AM/PM"))              |                 |
| 8            | =RENAME.COMMAND(1,"Time",2,TEXT(DATE(YEAR(NOW()),MONTH(NOW()),DAY(NOW())),"ddd mm dd, yyyy")) |                 |
| 9            | =ON.TIME(NOW()+TIMEVALUE("00:1:00"),"TIMEDATE.XLM!DisplayTime")                               |                 |
| 10           | =RETURN()                                                                                     |                 |
| 11           |                                                                                               |                 |
| 12           | PasteTime                                                                                     |                 |
| 13           | =FORMULA(TIME(HOUR(NOW()),MINUTE(NOW()),))                                                    |                 |
| 14           | =FORMAT.NUMBER("hh:mm AM/PM")                                                                 |                 |
| 15           | =RETURN()                                                                                     |                 |
| 16           |                                                                                               |                 |
| 17           | PasteDate                                                                                     |                 |
| 18           | =FORMULA(DATE(YEAR(NOW()),MONTH(NOW()),DAY(NOW())))                                           |                 |
| 19           | =FORMAT.NUMBER("ddd mm dd, yyyy")                                                             |                 |
| 20           | =RETURN()                                                                                     |                 |
| 21           |                                                                                               |                 |

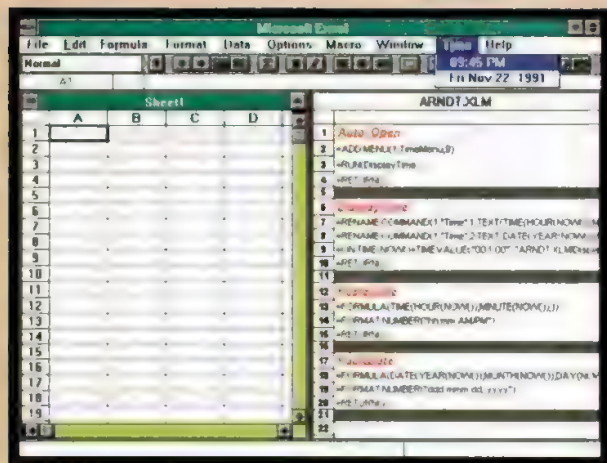
Figure 1: This macro adds a menu to your *Excel* menu bar that displays the time and date, and lets you paste them onto your current spreadsheet cell.



| TIMEDATE.XLM |          |                        | PARTIAL LISTING        |
|--------------|----------|------------------------|------------------------|
|              | C        | D                      | E                      |
| 1            | TimeMenu |                        | Comment                |
| 2            | TTime    |                        | Menu Name              |
| 3            |          | TIMEDATE.XLM!PasteTime | First Selection Macro  |
| 4            |          | TIMEDATE.XLM!PasteDate | Second Selection Macro |



**Figure 2:** This part of the TIMEDATE macro defines the added Time menu and its actions.



**Figure 3:** The TIMEDATE macro adds this menu to your Excel menu bar. If you click on the time or date, it will be entered into your current spreadsheet.

This is accomplished with the help of two RENAME.COMMAND functions and an ON.TIME function.

The RENAME.COMMAND function requires four arguments: the menu-bar number, the name (or position number) of the menu whose command is to be renamed, the name (or position number) of the command to be renamed, and the command's new name. So, for example, the function

`=RENAME.COMMAND(1,"Time",1,"blat")`

would tell Excel to change the name of the first command on the Time menu of menu bar 1 from whatever it is now to "blat." In both of Mr. Arndt's RENAME.COMMANDs, a TEXT function is used to supply "blat."

The first function

`TEXT(TIME(HOUR(NOW()),MINUTE(NOW()),0),"hh:mm AM/PM")`

returns the current time as a text string, formatted in 12-hour style with a capital AM or PM. The second TEXT function returns the current date as a text string, formatted to include the day of the week, an abbreviated month name, and a four-digit year.

In both cases, Mr. Arndt is unnecessarily complex. For the first TEXT function, you can substitute

`TEXT(NOW(),"hh:mm AM/PM")`

and for the second, you can use

`TEXT(NOW(),"ddd mmm dd, yyyy")`

The ON.TIME function tells Excel to

wait until your computer's internal clock reaches 1 minute past wherever it is now, and then execute the macro at DisplayTime—in other words, to update the names of the new menu commands once a minute. Note that Mr. Arndt's ON.TIME function includes the name of the macro sheet, as well as the name of the macro to be executed. This isn't required, but it's good practice.

Meanwhile, PasteTime, the macro executed by the first new menu command, uses a FORMULA function to enter the current time in the current cell. Then it uses FORMAT.NUMBER to format the time appropriately. The second macro, PasteDate, does the same thing with the current date.

Both of these macros can be simplified. In both cases, you can write

`=FORMULA(NOW())`

and then apply the appropriate time or date format to the worksheet cells where you do your time and date stamping. Another alternative for the PasteTime and PasteDate macros—one that I prefer—is listed in Figure 4. Because the values returned by Mr. Arndt's FORMULA functions are date values (as opposed to text), they may be too wide to display in the current cell. The alternative approach shown in Figure 4 changes the date stamp to a text label. If the cell isn't wide enough, the label spills into the neighboring cell.

I suggest that you save your macro as an add-in; this way you won't inadvertently open the macro again, putting another Time menu on the menu bar. Use the Save As command, hit the Options button, and choose the Add-In file format. Excel will change its extension to .XLA, so you must change any references to the file accordingly. If you need to edit an .XLA file, hold down the Shift key when opening it.

## HINTS, TIPS, QUESTIONS

Share your latest spreadsheet discovery through PC Magazine's Spreadsheets. We'll pay you \$50 for any tip we print. Please submit your letter on-disk, together with a printout. Mail your contribution to Spreadsheets, PC Magazine, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 10 for access instructions). We regret that we are unable to acknowledge submissions or answer questions individually.

| TIMEDAT2.XLM |                                    |                                           | PARTIAL LISTING |
|--------------|------------------------------------|-------------------------------------------|-----------------|
|              | C                                  | D                                         |                 |
| 15           | PasteTime                          | PasteDate                                 |                 |
| 16           | =FORMULA(TEXT(NOW(),"h:mm AM/PM")) | =FORMULA(TEXT(NOW(),"ddd, mmm dd, yyyy")) |                 |
| 17           | =RETURN()                          | =RETURN()                                 |                 |

**Figure 4:** An alternative to the PasteTime and PasteDate macros in TIMEDATE.XLM.



by  
Frank J. Derfler, Jr.

# Connectivity

## MORE MEMORY FROM MORE MUSCLE

We have many original IBM ATs in our company running on a *NetWare* 3.11 network. We hear a lot of hype about how DOS 5.0 can provide more memory for our applications, but we currently use XMSNET3, which takes the extra 64K above 1MB. Will we really get much benefit from DOS 5.0?

Willie Barnett  
Houston, Texas



The problem of what to do with 286 PCs, particularly when the network environment makes it desirable for everyone to run the latest applications—most likely under Windows—faces all but the luckiest network administrators. DOS 5.0 alone can't do much for the memory problems of a networked PC. Since you have real IBM PC ATs, you'll be interested in a product called SX/NOW! from Kingston Technology Corp., which gives you all of the memory benefits of a 386 computer. SX/NOW! is a small board that replaces the 80286 processor on your IBM AT's motherboard. It also works in a variety of other 286 machines such as those from AST, Compaq, and Hewlett-Packard.

The 386SX processor has a built-in memory management unit. After installing the SX/NOW!, you can use DOS 5.0's DOS=HIGH, UMB, and LOADHIGH commands to load your network drivers and any other programs into the memory between 640K and 1MB. Be sure to exclude the shared memory address that the network card may use to avoid conflicts. Additionally, you can turn your extended memory into expanded memory to run programs in 386 Enhanced mode under Windows or OS/2 2.0.

The SX/NOW! works equally well for QEMM, DR DOS, LAN Manager, OS/2 1.3 and 2.0, and Windows. The 20-MHz version sells for \$475. If you'd like more information about this product you can contact Kingston at 714-435-2600.

■ **MORE MEMORY FROM MORE MUSCLE:** Improving memory management abilities by converting your 286 CPU to a 386SX.

■ **PROPER GROUNDING:** Good wiring can help save your equipment—and maybe a life.

## PROPER GROUNDING

I frequently install thin Ethernet cabling systems in our manufacturing plant and keep running into the term *properly grounded* in equipment documentation. How do I meet this requirement?

Henry Dulak  
Mosinee, Wisconsin



*Ground* in an electrical layout is measured in volts and means a point having zero *potential* (for doing work) with respect to any other spot in a particular circuit. All components use ground as their voltage reference, and systems typically contain one or more for power, signal lines, and (as a safety precaution) the case. The connection to your building's power ground (which goes literally into solid ground) is made through the third prong on the system's plug. Problems such as poor wiring can create differences in the potential between grounds.

Designers assume that signal and chassis grounds on a device will have to be the same (although they wish otherwise). This means that your equipment's case ground, which goes out through the green wire in its line cord, must be at a common potential with all other equipment grounds as well as the incoming power line's.

If building grounds aren't good on all AC circuits, you're just asking for equip-

ment and safety problems; your first act should be to have an experienced, licensed electrician check every one. I've received letters reporting electrical problems between PCs and printers plugged into different AC circuits. Mysteries like this can remain unsolved until someone happens to cause an unfortunate contact between both systems. Network cables typically present no grounding problems, since they remain electrically isolated from chassis and building grounds. Nevertheless, in a big manufacturing plant I'd carry a voltmeter around and make measurements between the outside of each T-connector and both the chassis ground and some "real" ground—a metal cold-water pipe, for example, or one of the building's metal structural members. Measure between pieces of equipment and between the equipment and metal fixtures and structures. You could find the cause of operational problems or maybe even save someone's life. Proper grounding aids the operation of devices such as AC surge suppressors, too.

Use a voltmeter with a relatively low impedance, around 20,000 to 50,000 ohms per volt, so you don't just measure stray currents imposed on the long cable. You can buy grounding clips that attach to an Ethernet terminator on one end and the wall-plate center screw on the other, but that does little good if the screw presents an inadequate AC ground.

## NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay \$50 for any tip that we print. Please submit your letter on-disk along with a printout. Then mail your contribution to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016. You may also contact Frank J. Derfler, Jr. via MCI Mail (MCI ID: 240-2931) or the LAN Labs fax machine (904-267-1578). We regret that we're unable to acknowledge submissions or answer letters individually. ■



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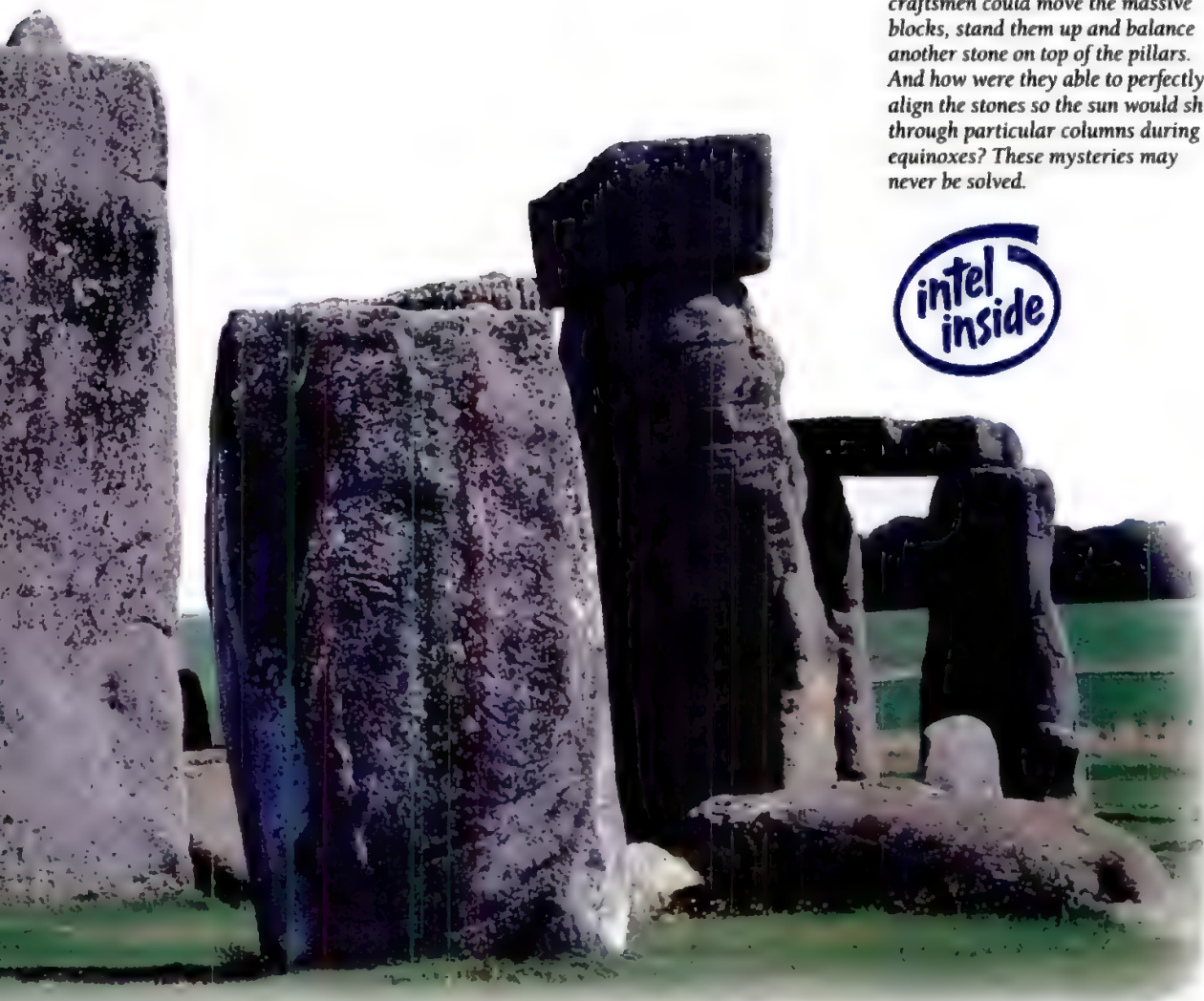
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2. When you receive a CONNECT or CARRIER DETECTED message, enter **Ctrl-C**.
3. At the HOST NAME prompt, enter **CIS**.
4. At the USER ID prompt, enter **177000,5000**.
5. At the PASSWORD prompt, enter **PC\*MAGNET**.
6. At the Enter agreement number prompt, enter **Z10D9000**.
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by  
Jim Freund

# PC MagNet

## VIRUS DEFENSE

Recently a user logged onto ZiffNet and asked why we recommend using antiviral software on downloads: Don't we check the software we offer on-line? As a matter of discipline, we always do.

Our homegrown software, the *PC Magazine* utilities, are checked and double-checked for viruses by our support associate, along with all other files to be uploaded from *PC Magazine*. Then, if they are virus-free, they are posted.

Just because a file has been posted, however, it is not automatically available for downloading. When a file is posted by us or by a ZiffNet subscriber, it can be accessed at this point only by a sysop (system operator). A sysop then downloads these files and checks them for—among other things—viruses. When a file passes the test, only then is it made available for downloading.

Although we individually and collectively check for viruses, we continue to advocate that you use one of the many available antivirus utilities. These usually have three modules. First, and most common, is the *scanner*, which checks your files for code known to be within viruses. Next is a module that will eradicate the virus, if at all possible. Third is software that attempts to protect your system by running a TSR.

The TSR constantly watches for unusual and potentially harmful activity, such as an application trying to write to Track 0 of your disk (hence, overwriting your boot sector). Sometimes the software will include a scheme that inoculates your files, or checks its own code to confirm that nothing has changed since the last time you checked. The TSR portion of some antivirus software can be costly in terms of memory (as high as 40K in some circumstances), but with the right memory manager you may be able to load it into high or extended memory. (If this capability is not specified in the documentation, you may wish to check with the manufacturer to make sure this won't

■ **VIRUS DEFENSE:** Before we post any files on-line, we repeatedly inspect them for viruses, but you should still use antiviral software.

compromise the protection scheme.)

Checking the integrity of your system should be as natural as backing up your files. (You *do* back up regularly, don't you?) To ensure that the antiviral software is clean, it is best to boot your system from an original write-protected DOS floppy disk and run your scans from another write-protected floppy disk. For ease of use, you can make a system disk and add the scanning and cleaning software to it, perhaps with an AUTOEXEC.BAT file that runs it automatically.

We suggest a cyclic routine. Monthly, perform a complete system analysis of all your files. Weekly, check all your executable and overlay files. (Most scanning software offers this as an option or even as a default.) Finally, scan every downloaded executable file. You could download your files to a floppy disk, but that slows downloading to a crawl. A better way is to maintain a distinct directory where you will decompress your files (files offered on BBSs and on-line services are compressed to save on download time) and subsequently scan them.

There is a good selection of data/system integrity safeguarding systems available, and we recommend you make use of at least one of these. The October 29, 1991, feature, "On Guard: 20 Utilities That Battle the Virus Threat," covered this topic. While several of these are found only through standard commercial distribution channels, we have quite a few shareware or freeware antiviral software packages available for downloading in PC MagNet's Utilities/Tips Forum.

Perhaps the best known is McAfee Associates' suite of shareware utilities. Each is a separate module, as outlined earlier in the column: SCAN.ZIP (VirusScan) is the scanner, NETSCN.ZIP serves the same purpose for a network server and is intended to be run from a node (preferably by someone with rights to all directories), CLEANP.ZIP is an eradicator, and VSHLD.ZIP is the TSR utility. A Windows version of the software is available in WINSCN.ZIP. Third-party packages enhance the value of the McAfee utilities: You can find a couple of shells to add ease of use, and SHEZ.ZIP is a front end for compression utilities. The latter lets you decompress files and run VirusScan on their contents.

Microcom Systems competes with McAfee with VIRX.ZIP, a fully functional freeware scanner, with some eradication functions built in. And Software Concepts Design competes with its FSPZIP (Flu\_Shot+), a shareware TSR utility (awarded *PC Magazine's* Editors' Choice in the April 25, 1989, issue). Stiller Research's shareware entry, I-MAST.EXE (Integrity Master—a self-extracting archive file), takes a new and comprehensive approach to the situation by not only scanning for viruses, but also detecting any changes to your data. With most scanning-type software, it is essential that you make sure you always have the latest version of the software, to ensure that you are checking for recently created viruses in your search. Most antivirus utilities are updated quarterly.

You may also want to peruse any of several archived threads of past PC MagNet virus-related discussions, or the essays that are on-line in files such as VIRUSD.ZIP and MYTHS.ZIP. To get a complete list of these and antiviral software available, go to the library section of the UtilForum and select Browse from the menu, ALL for which library to search, and VIRUS as the keyword; or type BRO \*.\* KEY:VIRUS LIB:ALL from the command line. ■



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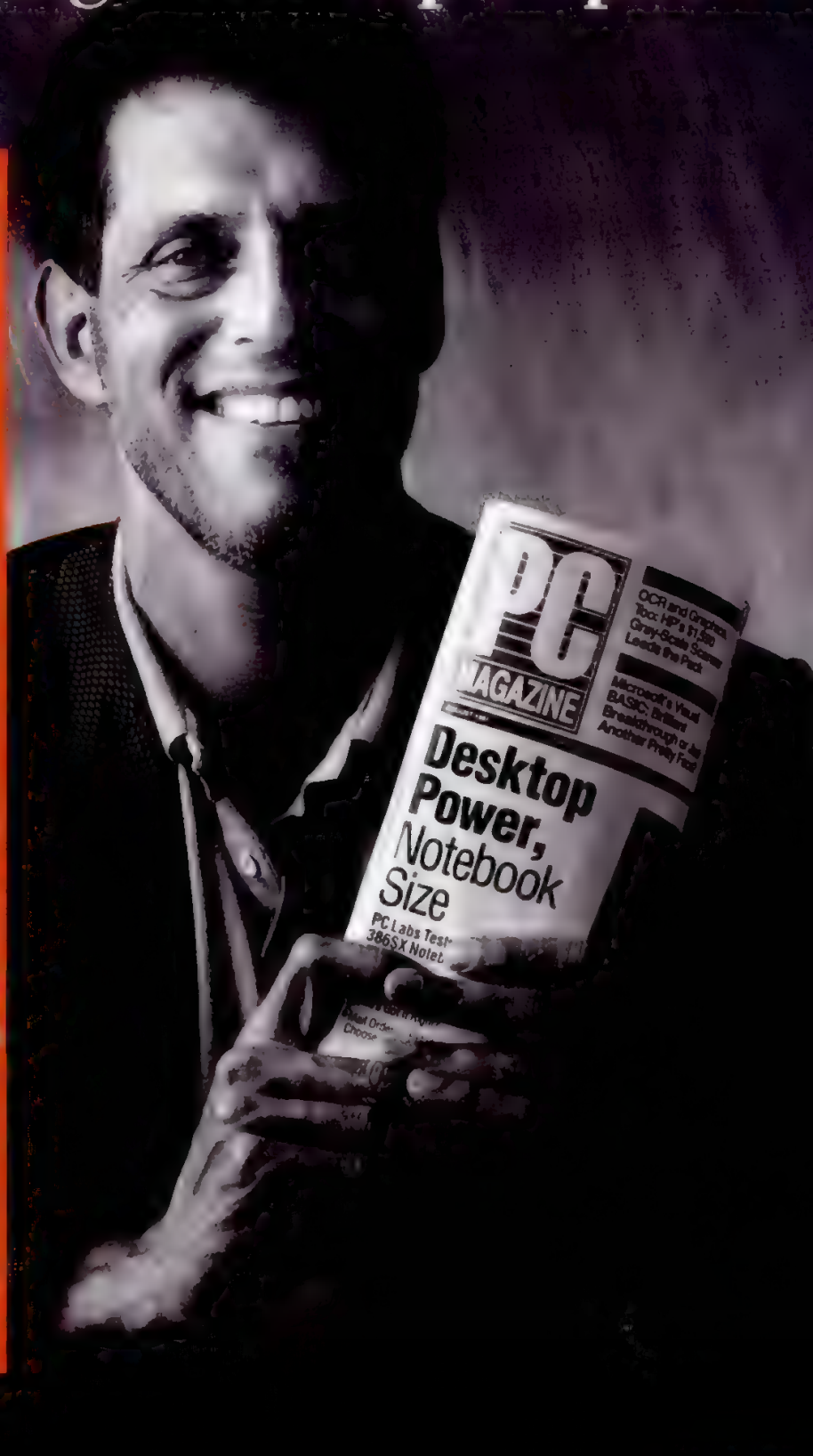
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by  
Michael J. Mefford

# Utilities

Longtime readers will remember the days when they had to type in every line of the assembly language or BASIC listings printed in *PC Magazine* before they could generate each issue's free utility. Today, of course, you can download all of our utilities in executable form from PC MagNet. If you want the source code files, however, you'll usually find them compressed into .ZIP files, which must be uncompressed before you can use them. The problem is that you may not have the necessary unzipper.

.ZIP files are created by running one or more files through Phil Katz's shareware utility, *PKZIP*, sold by PKWare. *PKZIP* compresses each file individually and permits a group of compressed files to be stored within a single .ZIP file. Since utility source files have mushroomed both in size and number in recent years—especially with the widespread use of C—storing files in a ZIPped format has almost become more of a necessity than a convenience. On average, .ZIP files take up only half as much space on a hard disk as do their uncompressed originals. This also means that it costs you only half as much in CIS connection time to download them.

If you've got a copy of *PKUNZIP*.EXE—and you've paid for it—you've already got all you need to uncompress the .ZIP files on PC MagNet and such other ZiffNet services as the PC/Contact of our sister publication, *PC/Computing*. If you don't have *PKUNZIP*, however, what you need is this issue's free utility, *PCUNZIP.COM*. *PCUNZIP* doesn't have all the optional bells and whistles incorporated in *PKUNZIP*, but it's small (5K as opposed to 21K), it does the job, and it's absolutely free.

You can download the executable file from PC MagNet (listed as *PCUNZIP.COM*, without the I), as explained in the sidebar, "Downloading Utilities." You can then use it to extract the assembly language source file (listed in PC MagNet as *PCUNZIP.ZIP*). An uncompressed BA-

## Decompress Your .ZIP File Downloads with PCUNZIP.COM

■ Here's the handy way to extract and restore the files you download from PC MagNet if you haven't got a copy of *PKUNZIP.EXE*.

SIC listing, *PCUNZIP.BAS*, is also available for download if your modem software can't handle binary files. Alternatively, you can request a copy of *PCUNZIP.ASM* or *PCUNZIP.BAS* by mail or fax. Just send or fax a postcard with your name and address or fax number to the attention of Katherine West, Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016; no phone calls, please!

The following is the complete syntax for *PCUNZIP*:

```
PCUNZIP filename [\path] [/V] [/E]
[/O] [/?]
```

By default, every file that is included in *filename.ZIP* will be decompressed. You do not need to type in the .ZIP extension, and you can use the DOS \* and ? wildcards as part of the *filename* if you would like to unzip more than one .ZIP file with a single command.

The optional *\path* can be used to tell *PCUNZIP* where to store the unzipped files. Any directories in *\path* must already exist; *PCUNZIP* will not create them. If no *\path* parameter is supplied, the

decompressed files will be stored in the current directory.

Thus, for example, if you download *DR.ZIP* from PC MagNet and want to decompress both of its two component files, *DR.COM* and *DR.ASM*, into the \PCMAG directory on the current drive, all you need to enter is

```
PCUNZIP DR \PCMAG
```

Naturally, if you keep all your *PC Magazine* utilities (including *PCUNZIP*) in a \PCMAG subdirectory, you will want to put it in the PATH statement in your *AUTOEXEC.BAT* file. That way, all your utilities will be accessible immediately from anywhere on your disk.

*PCUNZIP* supports three optional switch parameters. The /V (view) switch lets you see the names of the files contained in the .ZIP file without decompressing them. In the example just given, entering the following line

```
PCUNZIP DR /V
```

would produce the display

```
DR      ASM      651#5    5-25-91   7:33p
DR      COM      3391     5-25-91   7:33p
```

As you'll note, the listing is in the familiar DOS DIR format.

The /E (extract) option lets you extract and decompress either a single named file or a group of files formed by using a DOS wildcard. Thus, you would enter

```
PCUNZIP DR /E DR.COM
```



to extract DR.COM and leave DR.ASM compressed in DR.ZIP. Note that both the /V and the /E switches also support the use of the \* and ? wildcards.

If a file to be extracted already exists in the destination directory, PCUNZIP warns you and asks whether you want to overwrite it. Answer (Y)es to overwrite or (N)o to skip that filename and go on to the next compressed file. If you are sure you want freshly decompressed versions of any same-named files in the subdirectory, you can eliminate the warning prompt by adding the /O (overwrite) switch on the PCUNZIP command line. Entering PCUNZIP /? displays a help screen that shows the utility's syntax and options.

Katz's PKUNZIP has many more options than these (like handling encrypted files), and you should investigate that utility if you think you may need them. PCUNZIP uses the same basic decompression algorithm, however, and will work on the same unencrypted .ZIP files. When PKZIP is updated to include a new compression algorithm, a corresponding new version of PCUNZIP will be made available for download before any PC MagNet files make use of the new PKZIP version.

#### HOW PCUNZIP WORKS

Like most utilities, PCUNZIP begins by allocating enough memory for its own

working room and parsing the command line. Although the program itself is only a little over 5K in size, it requires 180K of free working memory. This space is

**PCUNZIP uses the same basic decompression algorithm as PKUNZIP and will work on the same unencrypted .ZIP files.**

needed for reading the compressed file and for constructing a workspace for decompression and storage of a sizable amount of the decompressed file before the latter is written to disk. PCUNZIP gracefully exits with a message if not enough memory is available.

The command line parsing is fairly

simple. PCUNZIP attempts to open the file with the name found as the first argument on the command line. If this fails, PCUNZIP tacks the extension .ZIP to the filename and tries to open the file again. If there is no argument or if both open attempts fail, PCUNZIP displays the syntax message and exits.

Next, the command line is examined for a second argument other than a switch command. If found, that argument will be the target directory for the extracted files. PCUNZIP makes the target directory current, extracts the file(s), and then politely returns to the original directory. If there is no target directory argument, PCUNZIP simply writes extracted files to the current directory.

If a forward slash /, followed by V, E, or O, is encountered during the command line parsing, PCUNZIP sets a flag variable. If the /V switch is flagged, it will display the filenames rather than extracting the files. When an /E switch is found, PCUNZIP looks for a filename following that switch on the command line and extracts only that file. The /O flag causes PCUNZIP to skip user confirmation when overwriting existing files.

#### PROCESSING THE LOCAL HEADER

Next, PCUNZIP has to establish that any file to be decompressed was in fact compressed with PKZIP and if so, it must process the .ZIP file header.

For each file compressed into a .ZIP file there is a local file header whose fields contain information about the file. The local header, which is diagrammed in Figure 1, is followed by the file's data in compressed form. It is unnecessary here to describe each field in detail or even in sequence, but a few fields deserve comment.

The first header field contains a 4-byte signature whose rendition in the code looks like this:

"PK", 3, 4

The two letters, of course, are Phil Katz's initials, and the two numerals differentiate this signature from that used in the central directory header. (I'll discuss this more in just a moment.) If PCUNZIP doesn't find the local file header signature as the first 4 bytes of the file (field 1), it exits with a "Zip header not found" message.

Any additional compressed files in the

## PC MAGAZINE UTILITIES UPDATES

As with all good software, the programs presented in *PC Magazine* are upgraded and improved. You can get the modified versions by downloading them from PC MagNet. Here's a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ANSI.COM, Version 1.3  
BAT2EXEC.COM, Version 1.5  
BCOPY, Version 1.2  
BEN60A.EXE (Benchmark Series, Version 6.0a)  
CARDFILE.COM, Version 1.1  
CHKFRAG.EXE, Version 1.2  
CMDEDIT.EXE, Version 2.1  
CONFIG.CTL, Version 3.0  
DIRMATCH.COM, Version 2.0  
EMMA.COM, Version 2.2  
EMS40.SYS, Version 1.1  
PANDORA.COM, Version 2.3  
PCACCESS.COM, Version 1.1

PCMANAGE.EXE, Version 1.1  
RN.COM, Version 2.0  
SCHEDULE.COM, Version 1.1  
SLICE.COM, Version 1.3  
SNIPPER.COM, Version 1.2  
TPFST-AT.COM, Version 1.1  
ZCOPY.COM, Version 1.4

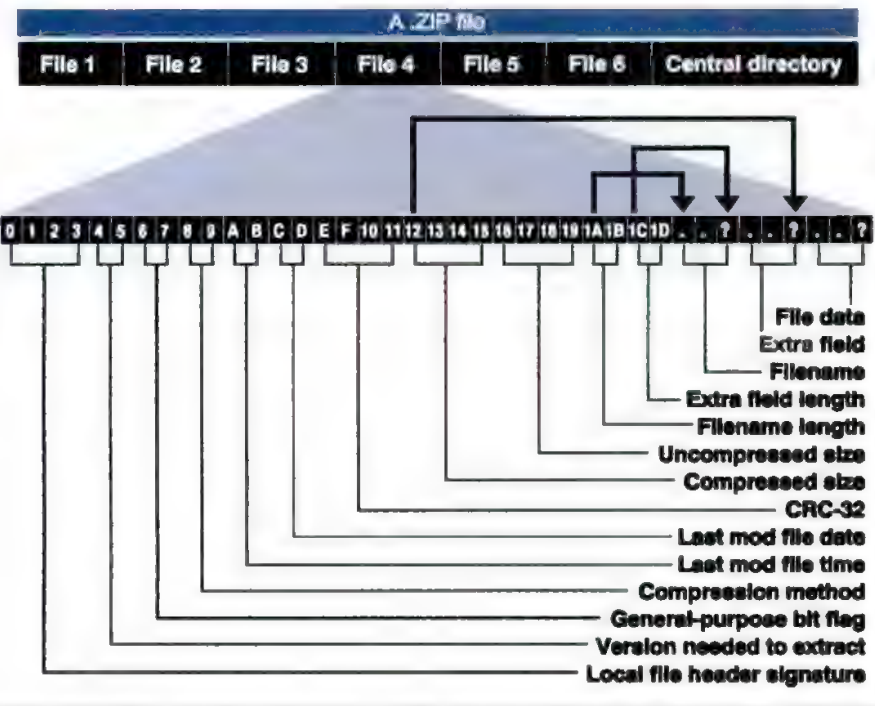
For a complete list of all the programs available from the PC MagNet Software and Utilities Database Library (SOFTLIB), download PCMCAT.ZIP.

A downloadable index to *PC Magazine's* product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine Reviews Index* for January 1988 to June 1991. It requires the search files in PCSRCH.EXE. Please read the information file PCM.INF before you download any of these files. ■





## THE LOCAL FILE HEADER



**Figure 1:** Each file that is compressed into a .ZIP file has a local file header that contains information about the file. The header's format is detailed above.

.ZIP file use the same format: a local header followed by the compressed file data. At the end of the compressed files is a central directory whose 4-byte signature appears in the code as

"PK", 1, 2

The central directory and its header contain information that applies to the entire zipped file. Other than to mark the end of the series of zipped files, these are of no interest to PCUNZIP and will not be covered here. (Complete details of the central header and the compression algorithms can be found in the file APPNOTE.TXT that comes with PKWare's *PKZIP*.)

We'll return, then, to the local header, which must be processed before a file can be extracted and decompressed. Field 2 indicates the minimum version number of PKUNZIP needed to extract the zipped file(s). If bit 0 of the general-purpose bit flag (field 3) is set to 1, the file was encrypted as well as compressed. Since encrypted files are not supported by PCUNZIP, if this bit is set, PCUNZIP

displays the message "File is encrypted" and exits without extraction.

The fourth field of the local header contains the compression type. Depending on the number and type of redundancies found in the file, *PKZIP* selects the most appropriate of four compression types. These are storing/unstoring, shrinking/unshrinking, reducing/expanding, and

imploding/exploding. If you've used *PKZIP*, you have seen these informal designations displayed on your screen as your file is being compressed. Their type numbers are listed in Figure 2.

Storing is actually not a compression algorithm at all. Because some files cannot be compressed by the methods *PKZIP* uses, the program uses this type designation to indicate that a file has been stored "as is," with only the local header added. The only time you would knowingly include a file that cannot benefit from compression in a .ZIP file is to keep a group of related files together.

The shrinking/unshrinking compression type uses a modified Lempel-Ziv-Welch method. Reducing/expanding employs the RLE method with one of four compression factors, and imploding/exploding is a combination of a sliding dictionary and the Huffman encoding method. Sometime, in the near future, Phil Katz intends to add still another and faster compression method to his utility. This new method is not supported by PCUNZIP at this time, of course, but as soon as Katz adds it, I'll update PCUNZIP to match.

As I mentioned earlier, further specifics about these compression methods can be found in Phil Katz's documentation file, APPNOTE.TXT, which can be downloaded from PC MagNet as part of the complete *PKZIP* shareware program. If you'd like more information you can find a much fuller treatment of different compression techniques in James A. Storer's *Data Compression Methods and Theory* (Computer Science Press, 1988).

For our purposes, it is sufficient to note that while processing the local header, PCUNZIP notes the compression type via the `PROCESS_TYPE` procedure listed in

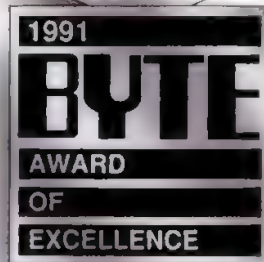
| PKZIP COMPRESSION TYPES |                                                                                                   |
|-------------------------|---------------------------------------------------------------------------------------------------|
| Type                    | Description                                                                                       |
| 0                       | The file is stored (no compression).                                                              |
| 1                       | The file is shrunk using a modified version of the Lempel-Ziv-Welch method.                       |
| 2-5                     | The file is reduced using the RLE method and a compression factor of 1, 2, 3, or 4.               |
| 6                       | The file is imploded using a combination of a sliding dictionary and the Huffman encoding method. |
| 7                       | Reserved for tokenizing compression algorithm.                                                    |
| 8                       | The algorithm to be used in a new version of <i>PKZIP</i> / <i>PKUNZIP</i> .                      |

**Figure 2:** *PKZIP* uses a variety of compression/decompression algorithms to find the optimum match to the redundancies in the file data.



# BEST DOS.

| REPORT CARD             |                       | INFO<br>WORLD         |            |
|-------------------------|-----------------------|-----------------------|------------|
| NOVEMBER 4, 1991        |                       |                       |            |
|                         | DR DOS<br>Version 6.0 | MS-DOS<br>Version 5.0 |            |
| <b>Performance</b>      |                       |                       |            |
| Memory handling         | Excellent             | Very Good             |            |
| User interface          | Very Good             | Very Good             |            |
| Speed                   | Good                  | Very Good             |            |
| Compatibility           | Very Good             | Very Good             |            |
| <b>Documentation</b>    |                       |                       |            |
| Documentation           | Excellent             | Very Good             |            |
| <b>Setup</b>            |                       |                       |            |
| Setup                   | Good                  | Very Good             |            |
| <b>Ease of learning</b> |                       |                       |            |
| Ease of learning        | Very Good             | Very Good             |            |
| <b>Ease of use</b>      |                       |                       |            |
| Ease of use             | Very Good             | Good                  |            |
| <b>Error handling</b>   |                       |                       |            |
| Error handling          | Satisfactory          | Satisfactory          |            |
| <b>Support</b>          |                       |                       |            |
| Support policies        | Good                  | Satisfactory          |            |
| Technical support       | Satisfactory          | Satisfactory          |            |
| <b>Value</b>            |                       |                       |            |
| Value                   | Excellent             | Excellent             |            |
| <b>Final Scores</b>     |                       | <b>7.6</b>            | <b>7.1</b> |



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D

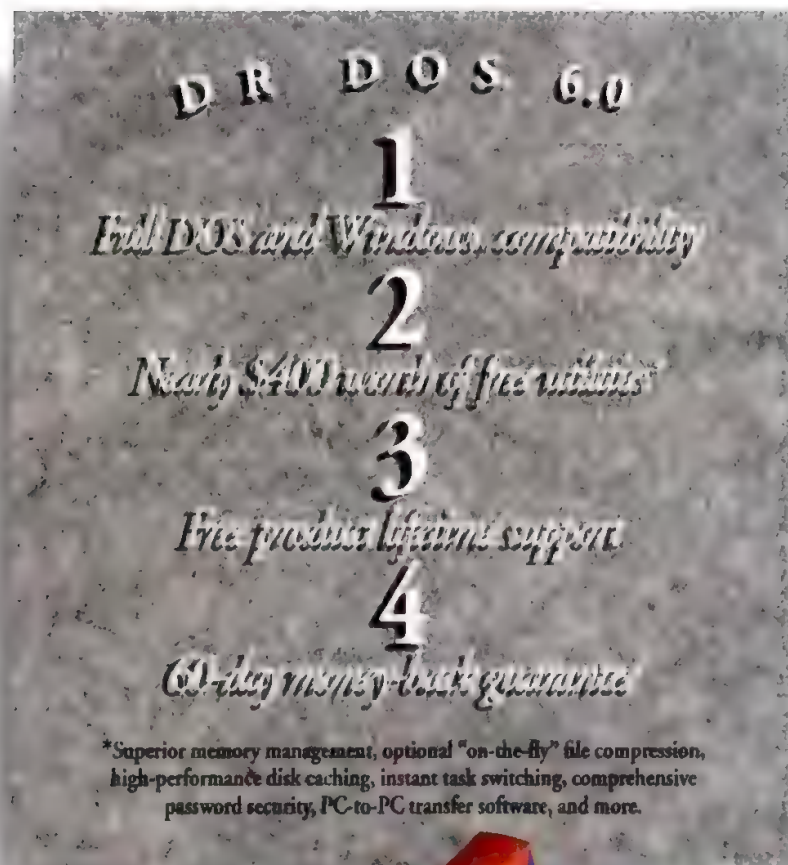
R

D

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CIRCLE 239 ON READER SERVICE CARD



# PROGRAMMING UTILITIES

Figure 3. If a type is not recognized, PCUNZIP exits with an "Unknown compression method" message.

The next step in PCUNZIP's operation is to see if there is room on-disk for the decompressed file. The ninth field in the header contains the uncompressed file size, and this is compared with the free disk space. If too large, PCUNZIP exits with a "Not enough free disk space to extract file" message.

Otherwise, PCUNZIP stores the other pertinent information from the local header. The uncompressed size, and last modified file time and date (fields 5 and 6), are utilized if the /V parameter is found on the command line. By adding together the compressed size of the data, the filename length, and the extra field length

**PKZIP uses a 32-bit cyclic redundancy check, which is more reliable than checksum or parity checking.**

(fields 8 through 10), it's easy to skip over a zipped file. PCUNZIP does this when the /E switch is used to specify that

a specific file should be extracted.

The last important piece of header information is the CRC-32 (field 7). To ensure an exact reproduction of the original file when decompressing a file, especially after modem transmission, a 32-bit CRC (cyclic redundancy check) number is transferred with the file. The value of this number depends on the value of all the bytes in the original file. During decompression, the CRC is calculated anew and checked against the original value sent with the file to make sure there were no transmission errors. If any bytes were changed, the CRC number will no longer match. The CRC is used because it is statistically more reliable than just a checksum or parity checking method. If the CRC number doesn't match, PCUN-

| PCUNZIP.ASM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  | PARTIAL LISTING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <pre> ;----- ;OUTPUT: AX=COMPRESS_SIZE[0]; BX=COMPRESS_SIZE[2]; ;       CX=FILENAME_LEN; CF=1 if failed. LOCAL_HEADER STRUC     SIGNATURE DB "PK",3,4     EXTRACT_VER DW ?     BIT_FLAG DW ?     SIP_TYPE DW ?     FILE_TIME DW ?     FILE_DATE DW ?     CRC_32 DW ?,?     COMPRESS_SIZE DW ?,?     UNCOMPRESS_SIZE DW ?,?     FILENAME_LEN DW ?     EXTRA_FIELD_LEN DW ?     LOCAL_HEADER ENDS  LOCAL_SIG DB "PK",3,4 CENTRAL_SIG DB "PK",1,2  COMPRESS_FLAG DB ? ;General purpose bit storage. TIME_STAMP DW ? DATE_STAMP DW ? FILE_CRC DW ?,? SIZE_HIGH DW ? SIZE_LOW DW ?  REDUCE_L DW ? ;Expansion technique REDUCE_P DW ? ;decompression factors. REDUCE_D1 DB ? REDUCE_D2 DW ?  ENCRYPTED_MSG DB "File is encrypted",CR,LF,LF,"\$" UNKNOWN_MSG DB "Unknown compression method",CR,LF,LF,"\$" INVALID_MSG DB "Invalid drive",CR,LF,LF,"\$" DISK_MSG DB "Not enough free disk space to extract file"             DB CR,LF,LF,"\$"  PROCESS_HEADER: PUSH DS                 MOV DS,READ_SEG ;zipped file buffer.                 MOV AX,DS:BIT_FLAG ;General purpose bit.                 MOV CS:COMPRESS_FLAG,AL ;store it.                 TEST AX,1 ;Is it encrypted?                 JNZ PROCESS_FAIL ;If yes, exit with msg.                  CALL PROCESS_TYPE ;Else process the type.                 MOV DX,OFFSET UNKNOWN_MSG ;If unknown, exit                 JC PROCESS_FAIL ;with msg.                  XOR DL,DL ;Else, get free disk space.                 MOV AH,36H                 INT 21H                 CMP AX,0FFFFH ;Did it fail?                 MOV DX,OFFSET INVALID_MSG                 JE PROCESS_FAIL ;If yes, exit with msg.                 MUL CX                 SUB AX,DS:UNCOMPRESS_SIZE[0]                 SBB DX,DS:UNCOMPRESS_SIZE[2]                 MOV DX,OFFSET DISK_MSG ;If not enough room for                 JC PROCESS_FAIL ;decompressed file, exit.                  MOV AX,DS:UNCOMPRESS_SIZE[0] ;Else save size.                 MOV CS:SIZE_LOW,AX                 MOV AX,DS:UNCOMPRESS_SIZE[2]                 MOV CS:SIZE_HIGH,AX                  MOV CX,DS:FILENAME_LEN ;Save filename length + </pre> |  | <pre>                 MOV DX,DS:EXTRA_FIELD_LEN ;extra field length +                 ADD DX,CX ;data size.                 MOV AX,DS:COMPRESS_SIZE[0] ;Return with compressed                 MOV BX,DS:COMPRESS_SIZE[2] ;size.                 STI,DS:FILE_TIME ;Save time/date stamp.                 MOV DI,DS:FILE_DATE                 MOV BP,DS:CRC_32[0]                 MOV CS:FILE_CRC[0],BP ;Save CRC-32.                 MOV BP,DS:CRC_32[2]                 CLC                 JWP SHORT PROCESS_END  PROCESS_FAIL: STC  PROCESS_END: POP DS              MOV FILE_CRC[2],BP              MOV BYTES_TO_READ[0],DX              MOV TIME_STAMP,SI              MOV DATE_STAMP,DI              RET  ;----- ;OUTPUT: CF=1 if failed.  PROCESS_TYPE: MOV BX,DS:SIP_TYPE ;Retrieve sip type.               OR AX,OFFSET UNSTORE               OR BX,BX ;If zero, it's stored-type.               JZ STORE_EXTRACT                MOV AX,OFFSET UNSHRINK ;If one, it's shrunk-type.               DEC BX               JZ STORE_EXTRACT                MOV AX,OFFSET EXPAND ;If two, it's reduced-type               MOV DX,7FH ;with compression factor               MOV CX,701H ;1.               DEC BX               JZ STORE_EXPAND                MOV DX,3FH ;If three, it's reduced-type               MOV CX,603H ;with compression factor               DEC BX ;2.               JZ STORE_EXPAND                MOV DX,1FH ;If four, it's reduced-type               MOV CX,507H ;with compression factor               DEC BX ;3.               JZ STORE_EXPAND                MOV DX,0FH ;If five, it's reduced-type               MOV CX,40FH ;with compression factor               DEC BX ;4.               JNE CX_EXPLODE  STORE_EXPAND: MOV CS:REDUCE_L,DX ;store reduced compression               MOV CS:REDUCE_P,DX ;factor.               MOV CS:REDUCE_D1,CX               XOR CX,CX               MOV CS:REDUCE_D2,CX               SHORT STORE_EXTRACT  CX_EXPLODE: MOV AX,OFFSET EXPLODE ;If 6, it's imploded-type.             DEC BX             JZ STORE_EXTRACT             STC             JWP SHORT TYPE_END  STORE_EXTRACT: MOV CS:EXTRACTOR,AX ;Store extractor type. TYPE_END: RET </pre> |  |

Figure 3: This code segment processes each of the local file headers in a .ZIP file.

## DOWNLOADING UTILITIES

The *PC Magazine* utilities are available by modem from PC MagNet, our on-line service.

To find the phone number nearest you, dial 800-346-3247 using your modem. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the number closest to you. Or you can call 800-635-6225 and follow the instructions and note the number.

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Dial the local number. When you connect, type Ctrl-C. At the HOST NAME prompt, type CIS. At the USER ID prompt, type 177000,5000. At the PASSWORD prompt, type PC\*MAGNET. At the ENTER AGREEMENT NUMBER prompt, type PCMAG92.

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# PCUNZIP Command

Michael J. Mefford

March 31, 1992 (Utilities)

## Purpose:

Provides a smaller, no-cost alternative to the shareware utility PKUNZIP.EXE for decompressing .ZIP files downloaded from PC MagNet and elsewhere.

## Format:

`pcunzip filename [\path] [/V] [/E] [/O] [/?]`

## Remarks:

Entered simply with a *filename* (adding the .ZIP extension is unnecessary), PCUNZIP uncompresses all files within a .ZIP file into the current directory. A path to an existing subdirectory can be supplied if it is desired to store the decompressed file(s) elsewhere. The optional /V (view) switch can be supplied to display a listing of the files contained in a given .ZIP *filename*. The /E (extract) switch, followed by the name of one of these contained files, will extract and decompress only the named file. By default, PCUNZIP issues a confirming prompt before overwriting a same-named file in the target subdirectory. This warning can be overridden by executing PCUNZIP with the /O switch.

PCUNZIP and its /V and /E options support the use of the DOS \* and ? wildcards. This enables viewing or extracting all or only the similarly named files for a C program, for example. Unlike the full PKUNZIP utility, however, PCUNZIP does not support the decompression of encrypted files.

Updated versions of PCUNZIP will be made available for download to reflect any changes to the PKZIP program implemented in files on PC MagNet. PCUNZIP requires 5K of storage space and 100K of working memory.



## PCUNZIP.ASM

## PARTIAL LISTING

```

DISPLAY_NAME:  MOV     EXTRACTED_FLAG,TRUE

                MOV     DI,OFFSET VIEW_NAME ;Blank out storage.
                MOV     AL,SPACE
                MOV     CX,SIZE VIEW_NAME
                REP     STOSB

                MOV     SI,OFFSET OUTFILE ;Point to filename.
                MOV     DI,OFFSET VIEW_NAME ;Point to storage
                MOV     CX,NAME_LEN ;store 12 bytes of
                JMP     SHORT NEXT_STORE2 ; filename.

EXTENSION:      ADD     DI,CX
                MOV     CX,3
                SUB     DI,CX

NEXT_STORE2:    LODSB ;Get a byte.
                OR      AL,AL ;end of filename?
                JZ      END_STORE ;If yes, finish with blanks.
                CMP     AL,"." ;Is it the period?
                JZ      EXTENSION

                STOSB ;store byte.
                LOOP    NEXT_STORE2 ;Get next byte.
                ADD     DI,CX

STORE_SIZE:     PUSH    DI ;save pointer.
                ADD     DI,8 ;Move to end of bytes field.
                MOV     DX,SIZE_LOW ;Retrieve high and low words
                MOV     AX,SIZE_HIGH ; of size in bytes.
                MOV     BX,16

NEXT_SIZE:      STD ;Reverse direction.
                MOV     CX,DX ;Low word in CX.
                XOR     DX,DX ;Zero in high half.
                DIV     BX ;Convert to decimal.
                XCHG    AX,CX ;Retrieve low word.
                DIV     BX
                XCHG    AX,DX ;Retrieve remainder.
                ADD     AL,"9" ;Convert to ASCII.
                STOSB ;store it.
                MOV     AX,CX ;Are we done?
                OR      CX,DX
                JNZ     NEXT_SIZE ;If no, divide again.

                CLD ;Back to forward direction.
                POP     DI ;Retrieve pointer.
                ADD     DI,11 ;Move to date field.

STORE_DATE:     MOV     DX,DATE_STAMP ;Retrieve date.
                MOV     AX,DX
                MOV     CL,5 ;Shift to lowest bits.
                SHR     AX,CL
                AND     AX,1111B ;Mask off all but month.
                MOV     CL,8FFH ;Flag as no leading zeros.
                MOV     CH,"-" ;Delimiting character.
                CALL     STORE_WORD ;Store it.

                MOV     AX,DX ;Retrieve date.
                AND     AX,11111B ;Mask off all but day.
                XOR     CL,CL ;Flag include leading zero.
                CALL     STORE_WORD ;Store it.

                MOV     AX,DX ;Retrieve date for last time.
                MOV     CL,9
                SHR     AX,CL ;Mask off all but year.
                ADD     AX,80 ;Adjust to ASCII.
                CMP     AX,1990 ;Past year 2000?
                JB      DISPLAY_DATE ;If no, display. Else, adjust for
                SUB     AX,1990 ; next century. (Planning ahead!)
                MOV     CL,CL ;Display leading zeros.
                MOV     CH,SPACE
                CALL     STORE_WORD ;Store it.

TIME:           INC     DI ;Move to time field.
                MOV     DX,TIME_STAMP ;Retrieve time.
                MOV     AX,DX
                MOV     CL,11 ;Shift to hours bits.
                SHR     AX,CL
                PUSH    AX
                CMP     AX,12 ;Past noon?
                JBE     MERIDIAN
                SUB     AX,12 ;If yes, adjust.
                CMP     AX,0 ;Midnight?
                JNE     NOT_MIDNIGHT
                MOV     AX,12 ;If yes, adjust.
                MOV     CL,8FFH ;Suppress leading zeros.
                MOV     CH,":"
                CALL     STORE_WORD ;Store it.

                MOV     AX,DX ;Retrieve time.
                MOV     CL,5 ;Shift to minutes bits.
                SHR     AX,CL
                AND     AX,111111B ;Mask off all but minutes.
                XOR     CL,CL
                POP     DX ;Retrieve hours.
                MOV     CH,"p" ;Assume PM.
                CMP     DX,12 ;Is it PM?
                JAE     PM ;If no, AM.
                MOV     CH,"a"

PM:             CALL     STORE_WORD ;Store it.
                MOV     DX,OFFSET VIEW_NAME
                MOV     AH,9H
                INT     21H
                RET

;-----
; Converts a two byte hex number to decimal followed by delimiter.
; INPUT: AX = hex number; BL = 16; CH = delimiter character to store.
; CL = 0 if zeros are to be stored; CL = -1 if leading zeros ignored.
; ES:DI points to storage.
;-----
STORE_WORD:     DIV     BL ;Divide by ten.
                ADD     AX,"00" ;Convert to ASCII.
                CMP     CL,0 ;Are we to display leading zero?
                JZ      STORE_IT ;If yes, store as is.
                CMP     AL,"0" ;Is it a leading zero?
                JNE     STORE_IT ;If no, store it.
                MOV     AL,SPACE ;Else, store a space.
                STOSW
                MOV     AL,CH ;Store delimiter character also.
                STOSB
                RET

```

Figure 4: When displaying .ZIP file contents with the /V option, this code segment produces the DOS DIR-type listing.

ZIP notifies you with an "Extracted file may be corrupt" message.

#### VIEWING ZIPPED FILES

As indicated earlier, if you include the /V option on the command line, PCUNZIP displays only the filenames (in DOS DIR format) that are contained in the zipped file. The procedure for this display is listed in Figure 4.

File dates are stored in a 16-bit word in the format

yy yy yy yy mm mm dd dd dd

where mm is a number ranging from 1 to 12, dd is 1 to 31, and yy is 0 to 119 (1980 to 2099). To extract the year from the word, you first shift it 9 bits to the right. This effectively masks out the month and day bits and, at the same time, right justifies it thus:

0 0 0 0 0 0 0 0 0 y y y y y y y y

The next step is to add 80, for the year is zero-based on 1980. Since the DOS DIR file date format abbreviates the year to its last two digits (as do we when we write '92, for example), the 19 part of the year is ignored.

There must be an adjustment to this simple algorithm for dates beyond the year 1999. With 0 representing 1980, the year 2000 is represented by 20. Adding 80 to 20 results in 100, which is obviously one too many digits for our two-digit year abbreviation. Therefore, for the years 2000 and above, the results are adjusted by subtracting 100.

Just before the label DISPLAY\_DATE in the DISPLAY\_NAME procedure in Figure 4 you'll find the following lines that accomplish the year conversion and century adjustment:

```

MOV AX,DX
MOV CL,9
SHR AX,CL
ADD AX,80
CMP AX,1990
JB DISPLAY_DATE
SUB AX,1990

```

I first wrote this procedure several years ago, and at the time I was inclined to think that planning ahead for the year 2000 was rather whimsical. However, during development of PCUNZIP, another new year slipped by, reminding me that the whimsical 2000 code will become practical even sooner than I might wish. You might want to keep this in mind when coding date display procedures for your programs.

Michael J. Mefford is a contributing editor of PC Magazine.



by  
Douglas Boling

# Lab Notes

Page-mode memory. Static column RAM. Interleaved RAM. Are these and similar current buzzwords mere advertising hype, or will they significantly enhance the performance of the next computer you buy? In this Lab Notes I'll discuss the role of memory architecture in the basic design of the computer so you can evaluate the claims you read in the ads more intelligently.

Computer speed is determined by three major subsystems: the microprocessor, the memory subsystem, and the Input/Output (I/O) subsystem. Attention tends to center on the first, for each new Intel processor has been dramatically faster than its predecessor. Improvements in the speed of the I/O components, such as the video and disk subsystems, are also instantly noticeable. Though less visible, the evolving designs of memory subsystems are just as important in giving today's 486 powerhouses the might to rival their larger minicomputer cousins.

The reason is that individual subsystems' speeds must always be matched to each other. It does no good to speed up the microprocessor if the memory subsystem can't keep pace with it. Designing a computer with a 486 processor and the memory structure of an XT would be like putting bicycle tires on a Ferrari.

Microprocessors communicate with the other parts of a computer through the processor bus. The bus is simply a set of wires or lines (actually, copper traces on a printed circuit board). Some lines carry addresses, others data, and others transmit control signals. When the microprocessor wants to read some data from memory, it places the address of the memory location on the address lines, toggles a few control signals, then waits for a signal that the memory controller has placed the proper data on the data bus. This process, called the *processor bus cycle*, is repeated millions of times each second.

The number of data lines in the processor bus directly affects the rate of data transfer. The original PC and XT had

## How New Memory Designs Keep Pace With New Processors

■ Microprocessors can't run any faster than the rate at which memory supplies them with data. This short course in PC memory architecture explains how the new memory-accessing techniques work.

only 8 data lines. That meant that only 1 byte (1 bit per data line) could be transferred at a time. The 80286 microprocessor of the PC AT has 16 data lines and consequently can use a processor bus 2 bytes wide. The processor bus on systems using the 80386 and 80486 has 32 data lines and is thus 4 bytes wide. This allows twice as much data to be transferred during each bus cycle than does an 80286 design.

Microprocessors such as the 80286 and 80386 execute a bus cycle in two processor clock cycles. (The processor clock cycle is the time it takes the clock to change from a logical 1 to a logical 0 and back again.) For a 25-MHz 386, this means one complete processor bus cycle every 80 nanoseconds (80 billionths of a second). On the other hand, the typical dynamic RAM (DRAM) chips used in today's PCs can deliver data only every 130 to 200 ns. If the processor had to slow to the speed of the memory for every processor bus cycle, a 25-MHz 386 would perform more like a 12.5-MHz 286.

To overcome this limitation, computer designers have developed many different methods to improve the performance of the memory system. Some of these designs were originally developed for mainframe computers, but since today's laptops approach the speed of yesterday's mainframes, the same techniques work quite well in a desktop or even in a laptop environment.

### TWO FLAVORS OF RAM

The straightforward solution to slow memory response is to design memory chips fast enough to keep up with the processor. Such chips do exist; they are known as high-speed static RAM (SRAM). SRAM chips can be read in as little as 15 to 30 nanoseconds, which is fast enough to keep up even with a 50-MHz 486. Typical DRAM, by contrast, can be read at only half the speed of today's midrange microprocessors. Unfortunately, however, SRAM chips also cost 4 to 5 times as much as DRAM units. While this makes it too expensive to be used for system RAM, in smaller amounts high-speed SRAM does have vital uses in personal computers, as you will soon see.

DRAM has two major advantages over SRAM: It's relatively cheap and it packs a lot of bits into a very small space. A typical 1-megabit DRAM chip costs less than \$5. DRAMs are famous for their density. Four 4Mb DRAMs, which together take up only a few square inches, can hold the entire 700-page text of Tom Clancy's novel, *Red Storm Rising*.

When you look at a chip, you are not really seeing the chip itself but the pack-



age carrying the chip. DRAMs, like all chips, are placed in a package to protect them from environmental hazards such as dust and static electricity. The most popular package for chips is the DIP (dual in-line package). DIPs have that classic "black caterpillar" look: a row of pins running down each side. While the DRAM chip itself is small, the size of the DIP, which contains the chip, is generally determined by the number of pins.

The size of the DRAM package is important since a computer will generally need a number of DRAMs. To keep the size of a DRAM package small, 1Mb DRAMs are usually packaged in 18-pin DIPs. Not only does the low number of pins reduce the size of the package, but it also reduces its cost. Surprisingly, the cost of the package is a significant percentage of the cost of most chips.

DRAMs today are usually configured so that they are 1 bit wide. That is, a 1Mb DRAM has 1 million addresses, each holding 1 bit of data. In many computers, the DRAMs are placed on SIMMs (single in-line memory modules). These SIMMs are nothing more than tiny circuit boards that have a number of DRAMs on them. The advantage of a SIMM is that it even further reduces the package size needed for the DRAMs. While an 18-pin DRAM DIP may contain 1 million bits of data, a SIMM usually bundles eight 1Mb DRAMs, bringing the SIMM capacity to 1 million *bytes*.

All of the packaging gymnastics are performed to meet the twin goals of low cost and small size. The problem is that reaching these two goals has produced another not-so-small problem: There aren't enough pins on an 18-pin DIP to address all the memory in the DRAM!

To address every bit in a 1Mb DRAM chip directly would require 20 address lines alone ( $2^{20}$  = the 1,048,576 bits in the RAM). But how is a 20-bit address to be sent to a RAM chip with a total of only 18 pins, some of which must be dedicated to things other than address lines? The answer is a digital ballet called *address multiplexing*.

Address multiplexing works by dividing the address lines in half and sending each half into the chip separately. Two control lines, the Row Address Strobe (RAS) and the Column Address Strobe (CAS), tell the chip which part of the address is currently being presented. After the second part of the address is sent to the chip, the desired data bit is placed on the single data line.

While address multiplexing obviously takes time, it is not the only reason why DRAMs are so slow. The major cause lies in the internal design of the individual DRAM chip, which is discussed in the sidebar "Inside Dynamic RAM."

## INSIDE DYNAMIC RAM

by Douglas Boling

Static RAM is a simple idea and simple to use, but dynamic RAM is simple where it counts—in the design of the individual memory bit. Static RAM requires 4 to 6 transistors to handle each bit, while dynamic RAM stores bits in tiny capacitors, which are implemented by 1 to 2 transistors. Reducing the number of circuit elements needed for each bit saves valuable real estate within the chip, and this is the reason DRAMs can hold such large amounts of data in so small a space.

The space efficiency of the dynamic RAM cell has a price of its own, however. Capacitors are not switches, as are the flip-flops that are found in static RAM. Capacitors, rather, are devices that can temporarily store an electric charge. If a capacitor in a cell is charged, that cell holds a "1" bit. If the capacitor is not charged, the bit contains a "0".

To understand how capacitors are used as memory cells, imagine a shelf above your head with a cup of water on it. Since you can't see into the cup, the only way to determine whether the cup is full or empty is to tip it over. If water comes out, the cup obviously held water. But whether the cup did or did not have water in it before, it certainly doesn't have any after you've tipped it over. Refilling the cup is the only way to restore an original water-containing state.

This picture is conceptually similar to the way a dynamic RAM cell works. The capacitor holding a given bit may or may not be charged, but the only way to find out for sure is to discharge it. Since the bit can only be read by discharging the capacitor, any "1" value in the bit is no longer there. The solution to this problem is to recharge those capacitors that have already been

### A SIMPLE DRAM SYSTEM

Before considering the different techniques used to enhance its performance, it would be a good idea to start by describing the operation of a simple DRAM design, such as the one in the PC AT.

The 8-MHz 80286 in the original AT could execute one bus cycle every two

charged each time they are read. This discharge/recharge cycle takes time, and it is the primary reason dynamic RAM is slower than static RAM.

DRAM cells are organized in a matrix of rows and columns. When DRAM is read, an entire row is read into a buffer made up of static RAM chips that do not discharge when read. The proper bit is then sent to the data pin on the chip. The buffer is then written back into the row in order to recharge the capacitors in that row. This is the reason DRAM's access time is so much faster than its cycle time. While the data is available soon after the row buffer is filled, the DRAM cannot be read again until the row buffer has been written back into the original row.

One other problem with DRAM chips is that the capacitors in the DRAM cells lose their charge over time. Unlike cups, capacitors inherently leak. This means that unless every row in the matrix is read and rewritten every few milliseconds, any "1" data will be lost anyway. The process of rewriting each row in memory to recharge the DRAM is called the DRAM refresh. On the original PC, timer 0 was dedicated to indicating when a DRAM refresh cycle was needed. When timer 0 expired, the PC used its direct memory access (DMA) controller to read a location in memory. The address to read was then incremented and the timer reset. This refresh cycle took about 5 percent of the PC's processor power.

Today, many different techniques are used to refresh DRAM. Modern DRAM chips have built-in refresh circuitry that can be triggered by the PC when necessary. This internal circuitry reduces the load on the processor necessary for DRAM refresh. ■



clock cycles, or once every 250 ns. While this pace would seem slow enough to permit using unmodified DRAMs, IBM conservatively chose to slow things down even further by inserting one additional clock cycle to the bus cycle. Such delays—in the form of added clock cycles during which no work is done—are called *wait states*. Wait states are used whenever the processor must allow slower parts of the system to complete their tasks before proceeding. Adding one wait state lengthened the AT processor bus cycle to 375 ns.

AT memory typically used 256K x 1-bit DRAMs. A total of 9 such chips was needed to implement 256K of RAM. (The ninth chip was used for a parity bit.) Since the bus width of the 80286 is 16 bits, DRAM chips in the AT were added in groups of 2 bytes, or 18 chips.

When the 286 in the AT needed to read memory, the address was placed on the processor bus. The memory subsystem divided the address in two. Half the address was fed into the proper DRAMs at a moment when it would remain properly synchronized with other clock-governed events in the computer, using the RAS signal. The other half of the address was then clocked into the DRAM using the CAS signal. The 18 DRAM chips then produced the proper data bits on the data bus for the processor.

While the inclusion of one wait state slowed the processor, it did not affect system performance enough for IBM to include any of the now-standard memory speed enhancements to be described. It was the development of faster processors with still faster clock speeds that necessitated creative new approaches in personal computer memory design.

#### PAGE MODE

One of the simpler ways to improve the performance of a DRAM system is to use one of two techniques, called *page mode* and *static column* access. Since these two techniques are actually very similar, I'll concentrate on the former. Normally, a certain amount of *precharge time* is required for a DRAM cell to be reenergized after one access before it can be read a second time. Using page-mode DRAM chips—when the high part of a new address request is the same as that of the previous read—only the low part of the address needs to be clocked into DRAM. This saves half the time normally needed to access the data.

For example, if the processor reads

data from address 1A356h, which is 0001 1010 0011 0101 0110 binary, the address is split and sent to DRAM as 0001 1010 00 for the high part and 11 0101 0110 for the low part. If the next read is from address 1A358h, the high part of the address (0001 1010 00) is the same as the previous read. So the cycle can be a page-mode cycle.

**A nice feature of a page-mode design is that it takes only a few additional chips to implement.**

To understand how a set of page-mode DRAM chips can produce the second group of data bits without enduring the precharge time loss requires a brief discussion of how page-mode DRAM is designed internally. RAM chips are designed as a matrix of cells with rows and columns. The top half of the address that is clocked into DRAM becomes the row address into the matrix. The chip then reads the entire row into an internal buffer. The column address is then clocked into the chip to select the specific bit from the selected row. If the next bit to be read from DRAM is in the same row as the previous bit, the internal matrix of DRAM does not have to be accessed again, for the desired bit is still in the internal column buffer. The column buffer in a typical 1MB DRAM is 2,048 bits. This means that any access within this 2,048 buffer can result in a page mode rather than a normal cycle.

A nice feature of a page-mode design is that it takes only a few additional chips to implement. Most of the work in a page-mode design is performed by the DRAM chip itself. The only external circuitry needed is used to check if the current address is in the same page as the previous address so a page-mode cycle can be executed.

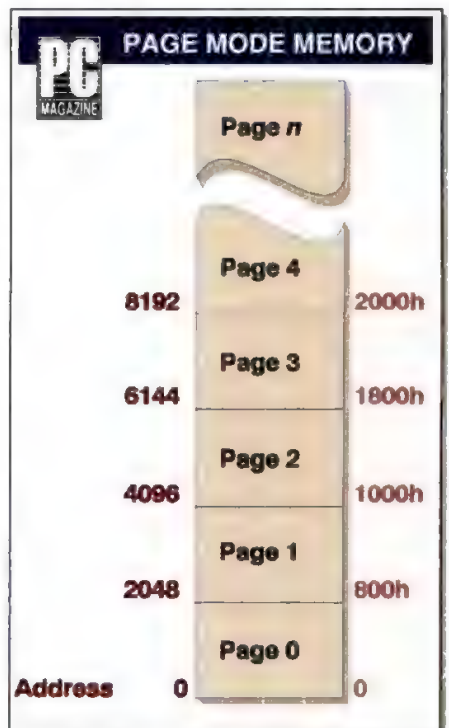
A typical page-mode cycle can be completed in 40 to 60 ns., as opposed to the long 130- to 180-ns. normal DRAM

cycle time. This improvement in cycle time can reduce the number of processor wait states from 3 to 1 during a typical page-mode cycle. Figure 1 shows a DRAM chip in a page-mode configuration.

Note in Figure 1 that for a page-mode cycle to be possible, the second access must be in the same *page* as the first. If the processor successively accesses address 780h and address 800h, the second cycle will not be a page-mode cycle even though the addresses are close together. This is because the addresses 780h and 800h are in different pages.

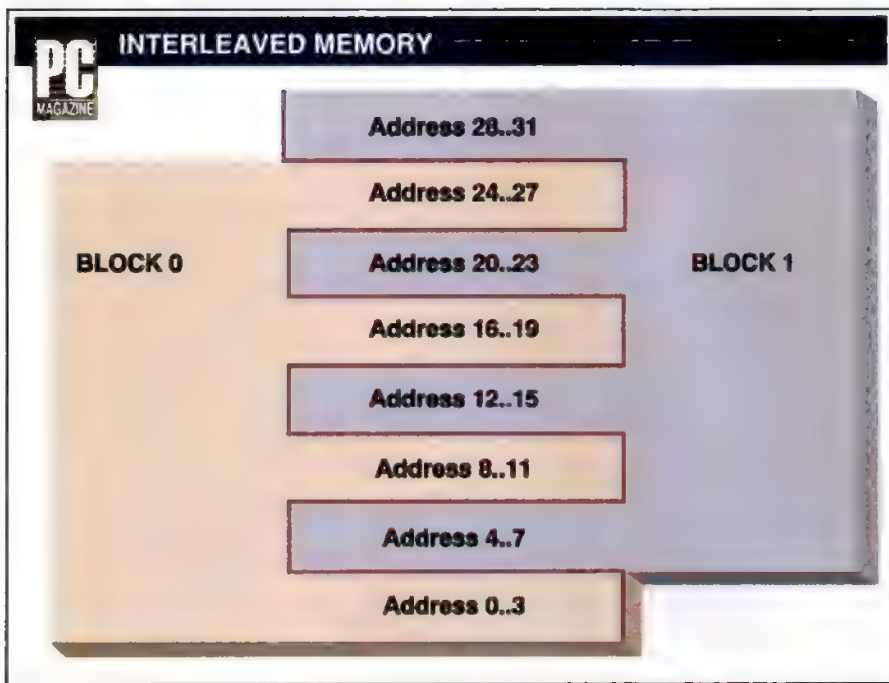
For a page-mode design to improve the performance of a system, the processor must make frequent memory accesses to addresses close together. Fortunately, memory reads and writes on computers tend to be clustered close to the last access. With this property, and with the small effort needed to implement the design, a page-mode memory system is one of the more popular memory designs for medium performance systems.

The difference between a page-mode design and a static column design has to do with the hardware design of the chip. In a page-mode design, the CAS signal



**Figure 1:** In a page-mode memory system, the memory is divided into pages by specialized DRAM chips. Consecutive access to memory addresses in the same page results in a page-mode cycle that takes half the time of a regular DRAM cycle.





**Figure 2:** In an interleaved memory design, addresses are assigned to different blocks of memory. In this figure, 2 blocks are used in a 32-bit interleaved design. As the processor reads through memory, the blocks are alternately accessed.

must be toggled during a page cycle for each new lower half of the address. In a static column design, the address change simply propagates through the chip without the need to clock the CAS signal. For this reason, a static column design can be slightly faster than a page-mode design. To the user however, the only difference is the specific DRAM chip number to buy when adding memory to the system.

#### INTERLEAVED RAM

*Interleaved memory* is another technique for improving memory performance. Interleaving takes advantage of an interesting property of DRAM chips: the difference between access time and cycle time. *Access time* is the interval between the time the DRAM chip receives its address and the time at which it presents the data. *Cycle time* is the minimum interval between two reads (accesses) of the same DRAM. Called *precharge time* above, the total cycle time of a DRAM chip is about 130 to 180 ns., but its access time is only 70 to 100 ns.

Interleaved memory uses a trick where it divides the memory into blocks from which the processor will read alternately. Thus, while the processor is reading data from one bank of RAM, the other bank gets time to precharge before being read

again. Of course, if the processor needs to read from the same bank of RAM repeatedly, it must wait for the full DRAM cycle time.

To make the processor alternately read from the different blocks, the addresses to be assigned to each block are intermixed by the width of the processor bus. For example, interleaved memory on a 386 machine with a 4-byte-wide processor bus would be configured so that block 0 would store the data from addresses 0 through 3, block 1 would store data from addresses 4 through 7, addresses 8 through 11 would be assigned to block 0, and so on. Since the processor is likely to read memory sequentially, the blocks are alternately accessed by default. Figure 2 shows a simple example of interleaved memory.

In most interleaved designs the memory is divided into either 2 or 4 blocks. The more blocks in the design, the less likely it is that the processor will need to access the same block on consecutive reads. An interleaved memory design has the advantage of not requiring the specially designed DRAMs necessary for page-mode or static column designs. The disadvantage is that memory must be added to each bank of RAM in equal amounts. This can double or quadruple the mini-

mum amount of memory that must be added when increasing the RAM in the system.

#### CACHED RAM

While a full static RAM solution is fast but expensive, and a full DRAM solution is cheap but slow, a compromise between these two designs makes for a very good memory subsystem design. In such a system, a relatively small block of static RAM is used as a *cache*, in which some of the data contained in slower DRAM is duplicated and stored until replaced. It's a little like keeping a photocopy of a page in a book that contains a diagram you need to consult frequently. You could of course find the pages in the book each time you needed to look at the table, but glancing at the photocopy is faster. Cached designs are used by almost all high-performance personal computer designs today.

In a cached memory design, the processor *directly* accesses only the 32K to 256K of fast static RAM that constitutes the cache. This RAM is fast enough so the processor can read from it with no wait states. The data to be stored in the static RAM is read from the much larger DRAM by the cache controller. The cache controller converts the addresses requested by the processor into the cache addresses that contain the data requested by the processor.

A bus cycle in which the data requested is not in the cache is called a *cache miss*. Similarly, when the data is already in the cache, it is called a *cache hit*. Cache misses dramatically slow the processor, since it must wait for the cache controller to read the data from the slow DRAM, put it in the cache, and direct the processor to it. The ratio of cache hits to the number of attempts to access the cache is called the *hit rate*, which is the key to the performance of a cached memory design. A well-designed memory cache should have a hit rate well above 95 percent.

The cache controller maintains a table containing the addresses of all the data currently in the cache. When the processor starts a bus cycle, the cache controller compares the address requested by the processor with the addresses listed in the address table. If the address is found in the table, the data is read from the cache instead of from the slower DRAM.

It's not easy being a cache controller. Its job requires it to compare every processor bus cycle address with the addresses in the address table. It must check the



table and return the data within the 40 to 80 ns. required for zero-wait-state operation of the processor. As the size of the cache increases, so does the size of the address table the cache controller must check, and unless the cache is itself well designed, the task can quickly become impossible.

There are three basic approaches to cache design. In a *fully associative cache*, data from DRAM is allowed to reside at any location within the cache. While this is the most flexible arrangement, its drawback, as just suggested, is that the cache controller must check each location in the address table each time the processor attempts to read from memory. With a cache of any significant size, this is a next-to-impossible task, since the cache controller must not only read the table but produce the data in less than 80 ns. if it is to keep up with the processor.

A second approach to cache design, the *direct-mapping cache*, simplifies the controller's job by restricting the data that can come from a given address range in memory to a specific location within the cache. This solves the problem of the

fully associative design, since the cache controller must now simply look at one location in its address table to determine whether the data is or is not present in the cache. This design is easily fast enough to keep up with the processor, but it suffers when the processor wants to make many consecutive reads from a particular section of memory. Since, as mentioned earlier, the processor *does* tend to cluster its memory accesses, and the assignable space in the cache for any given memory range is quite limited, the direct-mapping cache design is not very efficient.

The *set-associative cache* represents a compromise between the flexibility of the fully associative cache and simplicity of the direct-mapping cache. In a set-associative cache, the cache is divided into sets of cache locations dedicated to cache-specific address ranges of memory. The set-associative design offers some of the flexibility of the fully associative design, since data from locations in DRAM can reside in more than one place in the cache. The design is also efficient, since the cache

controller only needs to check a small number of locations in the cache address table to determine whether the cache contains the data requested by the processor.

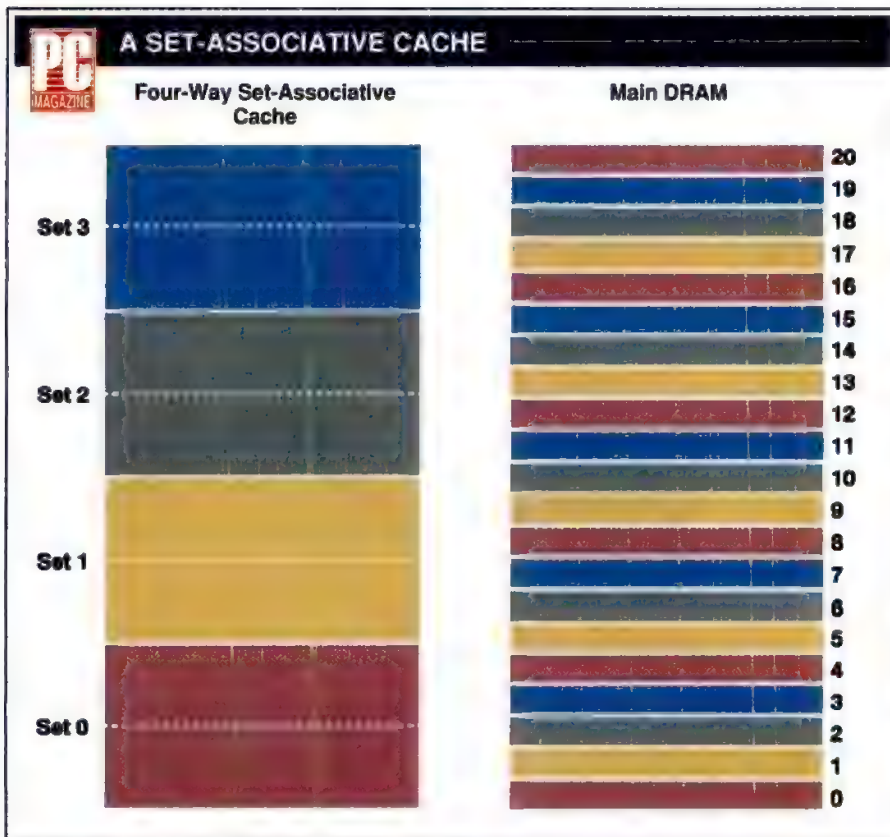
To keep pace with the speed of the processor, the *set size*—the number of cache locations dedicated to a section of memory—is kept between 2 and 8. This means that the cache controller need check only 2 to 8 table entries for each bus cycle. Since checking even one table entry is time-consuming, however, all entries in a set are usually checked simultaneously, using hardware built into the cache controller. The set-associative cache approach is the most popular design for memory caches.

Figure 3 diagrams a four-way set-associative cache design. In this example, Set 0 can cache data from addresses 0, 4, 8, and so on. Set 1 caches data from addresses 1, 5, 9 and so on. If the processor reads from address 15, the cache controller needs only to check the four locations in Set 3 to see if the data is in the cache.

To increase the hit rate of a cache, the cache controller takes advantage of the tendency of the processor to cluster reads around a given address. For example, if the processor reads from address 1000h, the cache controller will read into the cache not only the data from address 1000h, but also that of the next 8 to 16 bytes. Since it is likely that the processor will want the data at address 1004h on the next bus cycle, the cache controller pre-reads that data, ensuring that the processor's request will result in a cache hit.

When new data is read into a cache, the cache controller must make room by discarding data already there. Most cache controllers discard data using a least-recently-used (LRU) algorithm. Subject to additional limitations imposed by the type of cache involved, in a LRU approach, the cache controller places the new data in the cache address that contains any data the processor has not accessed for the longest time.

One advantage of using a memory cache is that the cache controller isolates the processor bus from the memory bus. The design of the memory bus, which communicates between the cache and the DRAM, is completely independent of the processor. This allows the design of the memory bus to be optimized for the cache and the DRAM. Thus, for example, the bus between the DRAM and the cache controller can be a different width than the processor bus. Instead of the 32-bit



**Figure 3:** This figure shows a four-way set-associative cache and how it relates to the main DRAM. In this simple example, the cache has four sets, each set capable of caching data from four different address locations.



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| Data Throughput up to 38,400 bps        | <input checked="" type="checkbox"/> |
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bus width on a 386 or 486, the cache controller may communicate with the DRAM using a 64-bit-wide bus. A wider bus improves the memory performance, because more bytes of data are transferred on each bus cycle.

Using a cache does not preclude using other techniques discussed previously for improving the speed of the memory system. In fact, most cached systems also use a page mode, static column RAM, or interleaved design to enhance the performance of the cache controller and DRAM.

The usefulness and shortcomings of a memory cache can be seen in the Intel 80486, which contains an internal 8K memory cache. The 486 uses a set-associative cache design with a set size of 4. The internal cache greatly improves the processor's performance when the data is in the cache, but the cache's limited size unfortunately lowers the hit rate to around 90 percent. Although that may seem to be an acceptably high rate, it is actually low for memory caches generally; their hit rate usually hovers around 95 to 98 percent. For this reason, many 486 machines today contain an external memory cache in addition to the one provided internally by the 486.

The Motorola 68020, 030, and 040 processors used in the Macintosh family make use of another interesting memory cache design. The Motorola processors maintain separate memory caches for instructions ("code") and data. The advantage of this design is that processors, while tending to cluster their memory accesses, actually cluster data accesses and instruction accesses separately. The Motorola cache design prevents the cache from losing frequently accessed data because the processor needs to fetch instructions from the same section of memory as the data. The advantage of this approach has not been lost on Intel, and rumor has it that the new 80586 processor will have separate caches for instructions and data.

The many different designs of today's memory systems are a result of the increasing performance of today's processors. With 50- and 66-MHz microprocessors just around the corner, new memory techniques will again be needed to keep pace. Memory design engineers shouldn't make plans to take any long vacations.

Douglas Boling is a contributing editor of PC Magazine.



by  
Charles Petzold

# Environments

In the early days of the Musical Instrument Digital Interface (MIDI), performers used MIDI in a very simple way—usually just connecting a couple of keyboards and synthesizers together as I discussed in the last issue. Introducing a computer into this configuration greatly enhances what you can do with MIDI. Composition software can send several channels of MIDI sequences to a MIDI board to play many instrument voices simultaneously. Although MIDI boards have been available for PCs for several years, programs written for them had to directly access the board's hardware.

Just as Windows introduced a device-independent application program interface (API) for displaying and printing text and graphics, Windows Multimedia Extensions includes a device-independent API to access MIDI boards.

Like the facilities for using waveform audio, MIDI is supported under Multimedia Windows in both a low-level and high-level interface. The low-level interface uses functions beginning with the prefixes *midiIn* and *midiOut*. The high-level interface involves playing standard MIDI files through the Media Control Interface (MCI). At the current time, reading MIDI input—that is, capturing MIDI sequences from an external keyboard or other controller—is supported only under the low-level interface, not MCI.

## MINIMUM STANDARD MIDI

Part of Multimedia Windows is the definition of minimum-standard hardware, referred to as the Multimedia PC, which includes a MIDI synthesizer and standard MIDI In and MIDI Out ports.

The minimum standards require a built-in MIDI synthesizer board that can handle at least six-note *polyphony*—that is, playing six notes simultaneously. The synthesizer must be capable of dividing these six notes among three *melodic* voices. The term *melodic* here indicates that the pitch of the notes depends on the key number being played.

## Device-Independent Access to MIDI Under Multimedia Windows

■ Just as Microsoft Windows introduced a device-independent API for displaying and printing text and graphics, Multimedia Windows includes a device-independent API for accessing MIDI boards.

In addition, the synthesizer must also include a *percussion* voice where each key number from 35 to 81 (decimal) plays a different percussion sound (drum, woodblock, cymbal, and so forth). This voice must be capable of 3-note polyphony.

MIDI software and MIDI files designed for Multimedia Windows are guaranteed that they can use four channels, that they can send Program Change messages over these four channels to select three melodic voices and the percussion voice, and then send Note On and Note Off messages on the melodic voice channels to play six-note polyphony, and messages on the percussion channel to play three-note percussion polyphony.

As I previously stated, the Multimedia PC hardware must also contain a MIDI In and a MIDI Out port. These ports are sometimes implemented in a small box that you connect to the MIDI synthesizer board. If you connect a MIDI keyboard or other MIDI controller to the MIDI In port, you can use the low-level MIDI interface

(the *midiIn* functions) to read and store the incoming MIDI messages.

The MIDI Out port is commonly used to connect an external MIDI synthesizer, which most likely is much better than the internal synthesizer. By better I mean that the synthesizer is capable of more simultaneous voices, greater polyphony, and better-sounding instruments.

Currently, I'm using a Sound Blaster 1 board (from Creative Labs) for my built-in MIDI synthesizer. The MIDI synthesizer on the Sound Blaster 1 is not great, but it's a popular board. I've also attached the MIDI Connector Box to this board. Generally, I connect the MIDI Out port of my Yamaha DX7 keyboard synthesizer to the MIDI In port of the connector box. (You could use any MIDI keyboard or controller for this.)

I've also connected one of the MIDI Out ports of the connector box to the MIDI In port of a Roland SC-55 Sound Canvas sound module. This is a rather pricey item (\$795 list) but it's tiny and sounds very good. The SC-55 also contains a mode to be compatible with the Roland MT-32, a very popular external synthesizer for attaching to MIDI boards.

This kind of setup—an internal MIDI synthesizer with MIDI In and MIDI Out ports connected to an external keyboard and an external synthesizer—is the most typical MIDI configuration for a Multimedia PC.

## THE MIDI DEVICES

Let's begin exploring the low-level MIDI API with the functions that let us determine the MIDI device capabilities. First



there are two functions for obtaining the number of MIDI input and output devices on the system. To get the number of MIDI input devices, you call the following function:

```
wNumDevs = midiInGetNumDevs ();
```

In a normal configuration, this function will return 1, which refers to the MIDI In port.

Similarly, you can obtain the number

of MIDI output devices:

```
wNumDevs = midiOutGetNumDevs ();
```

In a normal configuration, this function will return 2, indicating the built-in synthesizer and the MIDI Out port.

To get device capability information about these MIDI devices, you call `midiInGetDevCaps` and `midiOutGetDevCaps`:

```
wError = midiInGetDevCaps  
(wID, &midiincaps,  
sizeof (MIDIINCAPS));
```

```
wError = midiOutGetDevCaps  
(wID, &midioutcaps,  
sizeof (MIDIOUTCAPS));
```

For `midiInGetDevCaps`, the `wID` parameter can range from zero to one less than the number returned from `midiInGetNumDevs`, so in a normal configuration `wID` must be set to zero.

For `midiOutGetDevCaps`, the `wID` parameter can range from zero to one less than the number returned from `midiOutGetNumDevs`. In a normal configuration, this means that `wID` could be set to either 0 or 1 to obtain information about the two MIDI devices.

However, you can also pass the constant `MIDIMAPPER` (defined in `MMSYSTEM.H` as being equal to -1) as the first parameter to `midiOutGetDevCaps`. This is called the MIDI Mapper MIDI output device, and actually refers to one of the real MIDI devices on the system. I'll have more to say about the MIDI Mapper in the future. It's an important part of the MIDI support in Multimedia Windows.

These device ID numbers (including the constant `MIDIMAPPER`) are also used to open a MIDI input or output device using the low-level MIDI functions, and to specify an output MIDI port when using the Media Control Interface (MCI) to play MIDI files.

The second parameter to these functions is a pointer to a structure of type `MIDIINCAPS` or `MIDIOUTCAPS`. These structures (shown in Figure 1) are used to obtain information about the MIDI devices. The third parameter to these functions is the size of the structure.

The two functions return zero to indicate success, or an error code if an error—such as a bad ID number or an uninstalled device driver—occurs.

## THE MIDIDEVS PROGRAM

To display the information obtained from `midiInGetDevCaps` and `midiOutGetDevCaps`, I've written a program called `MIDIDEVS`, shown in Figures 2 through 5. To compile this program, you must have the Multimedia Development Kit (MDK) installed. If you're using the Microsoft C 6.0 Compiler, compile on the DOS command line with

```
nmake mididevs.msc
```

## THE MIDIINCAPS AND MIDIOUTCAPS STRUCTURES

```
typedef struct midiincaps_tag  
{  
    WORD    wMid ;           // manufacturer ID  
    WORD    wPid ;           // product ID  
    VERSION vDriverVersion ; // driver version  
    char    szPname[MAXPNAMELEN] ; // product name  
}  
MIDIINCAPS ;  
  
typedef struct midioutcaps_tag  
{  
    WORD    wMid ;           // manufacturer ID  
    WORD    wPid ;           // product ID  
    VERSION vDriverVersion ; // driver version  
    char    szPname[MAXPNAMELEN] ; // product name  
    WORD    wTechnology ;    // device type  
    WORD    wVoices ;         // number of voices  
    WORD    wNotes ;         // number of notes  
    WORD    wChannelMask ;   // channels used  
    DWORD   dwSupport ;      // feature flags  
}  
MIDIOUTCAPS ;
```

Figure 1: These structures are used for obtaining information about MIDI devices.

## MIDIDEVS.MSC COMPLETE LISTING

```
#-----  
# MIDIDEVS.MSC make file for Microsoft C 6.0  
#-----  
  
mididevs.exe : mididevs.obj mididevs.def  
    link mididevs,, NUL, /nod s1ibcew libw win87em mmsystem, mididevs  
    rc -t mididevs.exe  
  
mididevs.obj : mididevs.c  
    cl -c -G2sw -Ow -W3 -Zp mididevs.c
```

Figure 2: This is the Make file to use with the Microsoft C 6.0 Compiler.

## MIDIDEVS.BCP COMPLETE LISTING

```
#-----  
# MIDIDEVS.BCP make file for Borland C++ 2.0  
#-----  
  
mididevs.exe : mididevs.obj mididevs.def  
    tlink /c /n /Tw /Lc:\borlandc\lib c\ws mididevs, mididevs, NUL, \  
    /nod cwins cs import maths mmsystem, mididevs  
    rc -t mididevs.exe  
  
mididevs.obj : mididevs.c  
    bcc -c -w-par -W -2 mididevs.c
```

Figure 3: Use this Make file with the Borland C++ 2.0 Compiler.



With the Borland C++ 2.0 Compiler use

```
make -fmidevs.bcp
```

When you run the MIDIDEVS program under Multimedia Windows, you'll see a display something like the one in Figure 6.

The left half of the client area shows the fields of the MIDIINCAPS structure after calling midiInGetDevCaps for the device ID of zero. The right half of the client area shows the fields of the MIDIOUTCAPS structure after calling midiOutGetDevCaps for device IDs of -1 (the constant MIDIMAPPER), 0, and 1, in that order. (This information just barely

fits in the maximized client area on a VGA, so the program would have to be modified if multiple MIDI boards are installed in a system.)

## THE STRUCTURE FIELDS EXPLAINED

The left side of the client area shows the contents of the four fields of the MIDIINCAPS structure for the device ID of 0. The wMid field of the structure is 1, which corresponds to the constant MM\_MICROSOFT defined in MMSSYSTEM.H, meaning that Microsoft wrote the device driver.

The wPid field is a product ID number—4—corresponding to the constant MM\_SNDLST\_MIDIIN constant in MMSYSTEM.H and indicating that it's an external MIDI In port on a Sound Blaster board. The driver version is 1.00. The szPname field contains a text description of the device—"Sound Blaster 1 MIDI Input Port." You might use these text strings to display the different ports to the user for selection.

The MIDIOUTCAPS structure contains these same four fields plus five more. Information about the three MIDI Out ports is shown on the right half of the program's client area.

MIDIDEVS.C
1 OF 2

```

/*-----
MIDIDEVS.C -- Multimedia Windows MIDI Device Capabilities
(c) Charles Petzold, 1992
-----*/

#include <windows.h>
#include <mmssystem.h>
#include <string.h>

#define OUT TextOut (hdc, x, y, szBuffer, strlen (szBuffer)) ; y += cyChar ;

long FAR PASCAL WndProc (HWND, WORD, WORD, LONG) ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
LPSTR lpszCmdParam, int nCmdShow)
{
    static char szAppName[] = "MidiDevs" ;
    HWND        hwnd ;
    MSG         msg ;
    WNDCLASS    wndclass ;

    if (!hPrevInstance)
    {
        wndclass.style      = CS_HREDRAW | CS_VREDRAW ;
        wndclass.lpfnWndProc = WndProc ;
        wndclass.cbClsExtra  = 0 ;
        wndclass.cbWndExtra  = 0 ;
        wndclass.hInstance  = hInstance ;
        wndclass.hIcon       = LoadIcon (NULL, IDI_APPLICATION) ;
        wndclass.hCursor     = LoadCursor (NULL, IDC_ARROW) ;
        wndclass.hbrBackground = GetStockObject (WHITE_BRUSH) ;
        wndclass.lpszMenuName = NULL ;
        wndclass.lpszClassName = szAppName ;

        RegisterClass (&wndclass) ;
    }

    hwnd = CreateWindow (szAppName, "MIDI Device Capabilities",
        WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT,
        CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInstance, NULL) ;

    ShowWindow (hwnd, nCmdShow) ;
    UpdateWindow (hwnd) ;

    while (GetMessage (&msg, NULL, 0, 0))
    {
        TranslateMessage (&msg) ;
        DispatchMessage (&msg) ;
    }
    return msg.wParam ;
}

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam, LONG lParam)
{
    static char *szManuID [] = { "?????", "MM_MICROSOFT",
                                "?????" } ;
    static char *szProdID [] = { "?????", "MM_MIDI_MAPPER",
                                "?????", "MM_SNDLST_MIDIOUT",
                                "?????", "MM_SNDLST_SYNTH",
                                "MM_SNDLST_WAVEOUT", "MM_SNDLST_WAVEIN",
                                "?????", "MM_ADLIB",
                                "MM MPU401_MIDIOUT", "MM MPU401_MIDIIN",
                                "MM_PC_JOYSTICK", "?????" } ;
    static char *szTechID [] = { "?????", "MOD_MIDIPIPORT",
                                "MOD_SYNTH", "MOD_SQSYNTH",
                                "MOD_FMSYNTH", "MOD_MAPPER",
                                "?????" } ;

    static char szBuffer [MAXNAMELEN + 64] ;
    static short cxChar, cyChar, cxClient, cyClient ;
    HDC          hdc ;
    MIDIINCAPS   mic ;
    MIDIOUTCAPS  moc ;
    PAINTSTRUCT  ps ;

    short        i, x, y, iNumDevs ;

    switch (message)
    {
        case WM_CREATE:
            cxChar = LOWORD (GetDialogBaseUnits ()) ;
            cyChar = HIWORD (GetDialogBaseUnits ()) ;
            return 0 ;

        case WM_SIZE:
            cxClient = LOWORD (lParam) ;
            cyClient = HIWORD (lParam) ;
            return 0 ;

        case WM_PAINT:
            hdc = BeginPaint (hwnd, &ps) ;

            SetBkMode (hdc, TRANSPARENT) ;

            x = cxChar ;
            y = 0 ;

            iNumDevs = midiInGetNumDevs () ;

            for (i = 0 ; i < iNumDevs ; i++)
            {
                midiInGetDevCaps (i, &mic, sizeof (MIDIINCAPS)) ;

                wprintf (szBuffer, "mic.wMid: %04X (%s)", mic.wMid,
                    (LPSTR) szManuID [min (mic.wMid,
                        sizeof (szManuID) / sizeof (szManuID[0]))]) ;

                OUT

                wprintf (szBuffer, "mic.wPid: %04X (%s)", mic.wPid,
                    (LPSTR) szProdID [min (mic.wPid,
                        sizeof (szProdID) / sizeof (szProdID[0]))]) ;

                OUT

                wprintf (szBuffer, "mic.vDriverVersion: %08X",
                    mic.vDriverVersion) ;

                OUT

                wprintf (szBuffer, "mic.szPname: %s",
                    (LPSTR) mic.szPname) ;

                OUT

                MoveTo (hdc, x, y) ;
                LineTo (hdc, x + 39 * cxChar, y) ;

                x = 40 * cxChar ;
                y = 0 ;

                iNumDevs = midiOutGetNumDevs () ;

                for (i = MIDIMAPPER ; i < iNumDevs ; i++)
                {
                    midiOutGetDevCaps (i, &moc, sizeof (MIDIOUTCAPS)) ;

                    wprintf (szBuffer, "moc.wMid: %d (%s)", moc.wMid,
                        (LPSTR) szManuID [min (moc.wMid,
                            sizeof (szManuID) / sizeof (szManuID[0]))]) ;

                    OUT

                    wprintf (szBuffer, "moc.wPid: %d (%s)", moc.wPid,
                        (LPSTR) szProdID [min (moc.wPid,
                            sizeof (szProdID) / sizeof (szProdID[0]))]) ;

                    OUT

                    wprintf (szBuffer, "moc.vDriverVersion: %08X",
                        moc.vDriverVersion) ;

                    OUT

                    wprintf (szBuffer, "moc.szPname: %s",
                        (LPSTR) moc.szPname) ;
                }
            }
    }
}

```

Figure 4: This is the source code for the MIDIDEVS program.



MIDIDEVS.C

2 OF 2

```

INT
wprintf (szBuffer, "moc.wTechnology: %d (%s)",
        moc.wTechnology,
        (LPSTR) szTechID (min (moc.wTechnology,
        sizeof (szTechID) / sizeof (szTechID[0]))));
OUT
wprintf (szBuffer, "moc.wVoices: %d", moc.wVoices);
OUT
wprintf (szBuffer, "moc.wNotes: %d", moc.wNotes);
OUT
wprintf (szBuffer, "moc.wChannelMask: 0x%04X",
        moc.wChannelMask);
OUT

wprintf (szBuffer, "moc.dwSupport: %08X",
        moc.dwSupport);
OUT
MoveTo (hdc, x, y);
LineTo (hdc, x + 39 * cxChar, y);
}

EndPoint (hwnd, spe);
return 0;

case WM_DESTROY:
    PostQuitMessage (0);
    return 0;
}

return DefWindowProc (hwnd, message, wParam, lParam);
}

```

Let's begin with the one in the center, which is the result of calling `midiOutGetDevCaps` with a device ID of zero. The `wMid` field is again 1 (the driver was written by Microsoft) and the `wPid` field is 3, indicating an external MIDI Out port on a Sound Blaster board. The `wTechnology` field is 1 (corresponding to the constant `MOD_MIDIOUT`). Because there's no way to determine the number of simultaneous voices and notes on an external synthesizer, the `wVoices` and `wNotes` fields are set to 0. The `wChannelMask` has a bit set for each of the 16 channels that can be used—all channels are indicated here. The `dwSupport` field would normally indicate stereo support.

The structure fields displayed on the bottom of the client area are the result of calling `midiOutGetDevCaps` with a device ID of 1. This information refers to the internal synthesizer on the Sound Blaster board. The `wPid` field is 9 (corresponding to the constant `MM_ADLIB`) because the Sound Blaster synthesizer is compatible with the popular AdLib music board and uses the same driver. The `wTechnology` field is 4, indicating an FM synthesizer. (FM is a technique for generating complex tones from simple waveforms through the use of frequency modulation.) The `wVoices` and `wNotes` fields are both 11, indicating the synthesizer is capable of 11 simultaneous voices and notes. For reasons that escape me, the `wChannelMask` value indicates that only channels 1 through 8 are available; the Sound Blaster synthesizer can actually respond to all 16 channels. Currently, this driver does not support stereo.

At the top, the structure fields are shown for a device ID of `MIDIMAPPER (-1)`. The `wPid`, `szPname`, and `wTechnology` fields all indicate that this is the MIDI Mapper.

### THE MIDI MAPPER DEMYSTIFIED

As I mentioned in the last issue, MIDI synthesizers associate a particular instrument voice with a channel upon receipt of a MIDI Program Change message. Subsequent Note On messages for that channel use that voice.

However, one serious problem for device-independent MIDI programming is that different synthesizers do not implement

Program Change messages in the same way. The same program number can select different voices on different synthesizers. The MIDI Mapper is an attempt to introduce a higher level of device independence in Multimedia Windows' MIDI interface.

First, Microsoft has defined *base-level* and *extended* synthesizers. The base-level synthesizer is the Multimedia PC mini-

| MIDIDEVS.DEF                          |                                                      | COMPLETE LISTING |
|---------------------------------------|------------------------------------------------------|------------------|
| ;-----                                |                                                      |                  |
| ; MIDIDEVS.DEF module definition file |                                                      |                  |
| ;-----                                |                                                      |                  |
| NAME                                  | MIDIDEVS                                             |                  |
| DESCRIPTION                           | 'MIDI Device Capabilities (c) Charles Petzold, 1992' |                  |
| EXETYPE                               | WINDOWS                                              |                  |
| STUB                                  | 'WINSTUB.EXE'                                        |                  |
| CODE                                  | PRELOAD MOVEABLE DISCARDABLE                         |                  |
| DATA                                  | PRELOAD MOVEABLE MULTIPLE                            |                  |
| HEAPSIZE                              | 1024                                                 |                  |
| STACKSIZE                             | 8192                                                 |                  |
| EXPORTS                               | WndProc                                              |                  |

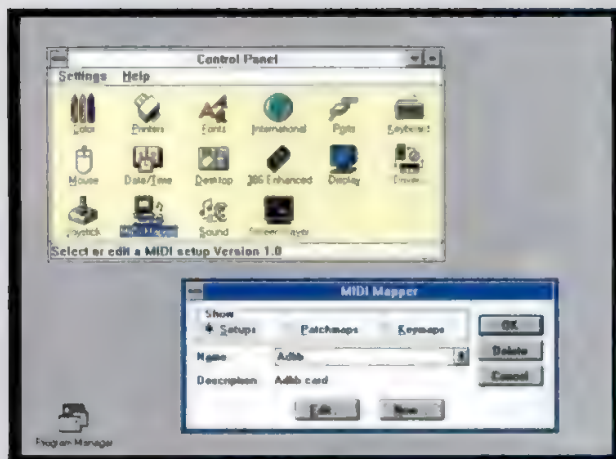
AVAILABLE ON  
**PC**  
MAGNET

Figure 5: Here is MIDIDEVS's module definition file.

Figure 6: The MIDIDEVS display under Multimedia Windows.

| MIDI Device Capabilities                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre> moc.wMid: 0001 (MM_MICROSOFT) moc.wPid: 0004 (MM_SNDBLST_MIDIIN) moc.vDriverVersion: 0x0100 moc.szPname: SoundBlaster 1 MIDI Input Port </pre>                                                                                                            | <pre> moc.wMid: 1 (MM_MICROSOFT) moc.wPid: 1 (MM_MIDI_MAPPER) moc.vDriverVersion: 0x0100 moc.szPname: Microsoft MIDI Mapper moc.wTechnology: 5 (MOD_MAPPER) moc.wVoices: 0 moc.wNotes: 0 moc.wChannelMask: 0x0000 moc.dwSupport: 00000004 </pre> |
| <pre> moc.wMid: 1 (MM_MICROSOFT) moc.wPid: 3 (MM_SNDBLST_MIDIOUT) moc.vDriverVersion: 0x0100 moc.szPname: SoundBlaster 1 MIDI Output Port moc.wTechnology: 1 (MOD_MIDIOUT) moc.wVoices: 0 moc.wNotes: 0 moc.wChannelMask: 0x0000 moc.dwSupport: 00000000 </pre> | <pre> moc.wMid: 1 (MM_MICROSOFT) moc.wPid: 9 (MM_ADLIB) moc.vDriverVersion: 0x0100 moc.szPname: Ad Lib® Synthesizer moc.wTechnology: 4 (MOD_FMSYNTH) moc.wVoices: 11 moc.wNotes: 11 moc.wChannelMask: 0x00FF moc.dwSupport: 00000000 </pre>      |





**Figure 7:** The MIDI Mapper utility is invoked from the Control Panel.

use the special ID value MIDIMAPPER (equal to -1), all MIDI channel messages go through a mapping process so they eventually conform to the General MIDI Mode specification. The messages are then sent to either the internal or external synthesizer. When you play a MIDI file through MCI, by default the MCI driver uses the MIDIMAPPER port, though you can bypass the MIDI Mapper with MCI.

## EXPLORING THE MIDI MAPPER

The utility for changing your current MIDI Mapper (or creating new MIDI Mappers) is invoked from the MIDI Mapper option in the Multimedia Windows Control Panel. When you first run this program, you'll see something like the display shown in Figure 7, which indicates that the MIDI Mapper is currently set to use the setup for an AdLib board. Selecting Edit on this window displays the Setup map, shown in Figure 8. The Setup map allows mapping any channel to any other channel, and directing the messages to a particular real MIDI output device, using a particular patch map.

As you can see, all MIDI messages going through the MIDIMAPPER port for channels 1 through 12 are discarded. MIDI messages for channels 13 through 16 are sent to the internal AdLib synthesizer. Because the AdLib synthesizer is initialized by the device driver to play General MIDI Mode melodic voices on channels 13, 14, and 15, and to use channel 16 as a percussion voice, no patch maps are required.

If you'd prefer that the MIDIMAPPER port use an external MT-32 synthesizer connected to the Sound Blaster board,

mum standard—capable of 6-note polyphony with 3 simultaneous melodic voices, and 3-note polyphony using a percussion voice. An extended synthesizer is defined as being capable of 16-note polyphony with 9 simultaneous melodic voices and 16-note polyphony using a percussion voice.

For base-level synthesizers, Microsoft recommends using channels 13 through 15 for the three melodic voices and channel 16 for the percussion voice. For extended synthesizers, you use channels 1 through 9 for the nine melodic voices and channel 10 for the percussion voice.

Second, Microsoft has adopted a set of 128 melodic voices recommended by the MIDI Manufacturers Association (MMA) for what is called the "General MIDI Mode" specification. These 128 voices are divided into 16 families (such as piano, organ, guitar, brass, sound effects) with 8 instruments in each family. This provides a device-independent standard for selecting voices using MIDI Program Change messages.

The AdLib and Sound Blaster internal synthesizers are base-level synthesizers. The device driver for these boards initializes the synthesizer hardware by loading voice definitions into it in accordance with the General MIDI Mode specification. Channel 16 is initialized as a percussion voice, where each key number from 35 to 81 plays a different percussion instrument. Although the AdLib driver initializes the board for the standard set of voices, it is conceivable that some internal synthesizers cannot be initialized in such a manner.

The external synthesizer I'm currently using with Multimedia Windows is the Roland SC-55 Sound Canvas, which meets Microsoft's criteria for an extended synthesizer and happens to conform to the General MIDI Mode specification. (That's one reason I bought it!) However, the popular Roland MT-32 (also considered to be an extended synthesizer) does not conform to General MIDI Mode. This is a problem.

The problem is solved by the MIDI Mapper. When you open a MIDI output device using the ID values 0 or 1 (or higher if you have multiple MIDI boards installed), then all MIDI messages are sent directly to the external MIDI port or the internal synthesizer, depending on the ID value you use. However, when you

**Figure 8:** The MIDI Mapper setup map for the AdLib sound board.





## PROGRAMMING ENVIRONMENTS

you'd select the "MT32 sb" setup from the combo box on the main window. If you now select Edit, you'll see the setup map shown in Figure 9, which indicates that MIDI messages for channels 1 through 8 going through the MIDIMAPPER port are mapped to channels 2 through 9, and the instrument numbers in the Program Change messages are mapped in accordance with the patch map known as "MT32." From the main window, you can select the "MT32" patch map for editing, and you'll see the window shown in Figure 10. In the General MIDI Mode specification used in Multimedia Windows, voice number 6 is defined as a harpsichord sound. This must be mapped to voice number 17 on the MT32 to play a harpsichord sound.

The "MT32 Perc" patch refers to the percussion voice. This map uses a key map for the percussion voice in case the key assignments need to be changed on their way to the external synthesizer.

### DEVICE-INDEPENDENT MIDI

As you can see from the information returned from the midiOutGetDevCaps functions, codes are provided that let a program identify the installed MIDI hardware. If your program recognizes a particular internal MIDI synthesizer and knows what Program Change messages correspond to what instrument voices, it can open that device and play the synthesizer by sending MIDI messages to it. The MIDI messages are sent directly to the synthesizer without modification.

If your program asks the user what external synthesizer is connected to the MIDI Out port, and your program is familiar

with the instrument voices that result from Program Change messages, it can also open that device and play the synthesizer intelligently.

But in most cases you'll want to open the MIDIMAPPER device for MIDI output because it provides something that approximates device-independent MIDI. Moreover, the user has probably (or let's say optimally) used the Control Panel MIDI Mapper to select whether MIDI output should go to the internal synthesizer or an external synthesizer. In the case of an external synthesizer, the user has also selected (or created) an appropriate set of maps.

To play MIDI music sequences in a device-independent manner using the low-level MIDI output functions, you would

open the MIDIMAPPER device and restrict yourself to three melodic voices with six-note polyphony and one percussive voice with three-note polyphony.

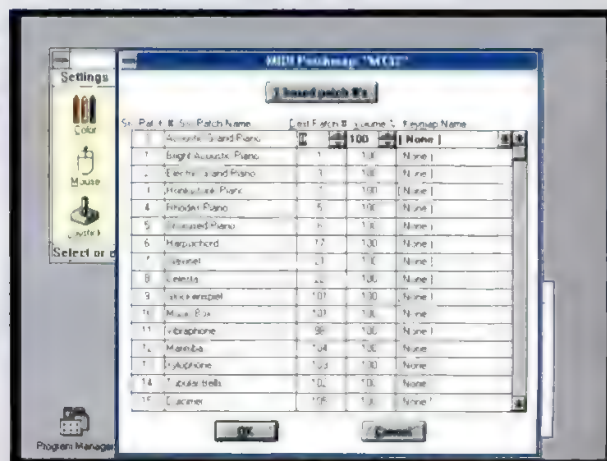
For the first melodic voice, you send the same Program Change message over channel 1 and channel 13 using the standard set of 128 instruments defined by General MIDI Mode. Note On and Note Off messages for that voice are also duplicated for channels 1 and 13. The second melodic voice would use channels 2 and 14, and the third would use channels 3 and 15. For playing the percussion voice, you direct MIDI messages to channels 10 and 16.

If the user has selected a base-level synthesizer in the MIDI Mapper utility, MIDI messages for channels 1, 2, 3, and 10 are discarded and messages for channels 13, 14, 15, and 16 are sent to the synthesizer. If the user selected an extended synthesizer, messages for channels 13, 14, 15, and 16 are discarded and messages for channels 1, 2, 3, and 10 are sent to the synthesizer. In either case, Program Change messages might be modified to play the correct instrument voice on the particular synthesizer being used.

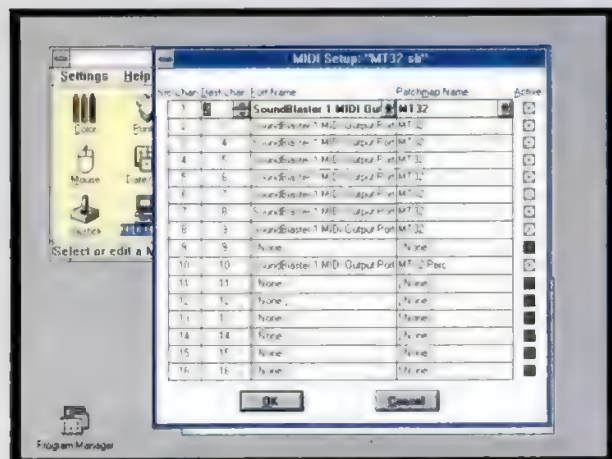
### MUSIC FROM YOUR KEYBOARD

I know this stuff can be confusing at first, because it took me a while to figure out what's going on with the MIDI Mapper. We'll explore these issues further in upcoming columns. In the next issue, I'll show you a program that uses the MIDIMAPPER output device to play some music in a device-independent manner. ■

**Figure 10: The MIDI Mapper patch map for the MT-32 external synthesizer.**



**Figure 9: The MIDI Mapper setup map for the MT-32 external synthesizer.**



by  
Ray Duncan

# Power Programming

## Creating a Custom Dictionary Module for Pen Windows

In the last issue we talked about the relationship between Pen Windows and two of its essential components: recognizers and dictionaries. We learned that the *recognizer* is the module that translates streams of (x,y) coordinates from the pen into structures called *symbol graphs*, which encode the set of possible strings represented by the handwritten input, and that a *dictionary* is a module that helps Pen Windows extract the most correct translation from the alternatives returned by the recognizer.

We saw that both of these components are implemented as ordinary Windows dynamic link libraries (DLLs) with well-documented interfaces and have the potential to be replaced by more-sophisticated third-party products. We also looked at a simple application (DEMO4.EXE) that uses the Microsoft-supplied USERDICT.DLL dictionary to validate user input and improve recognition accuracy, and found by experiment that USERDICT.DLL doesn't really work very well. In this installment, I'll show you how to build a custom Pen Windows dictionary of your own.

### DYNAMIC LINK LIBRARIES

Before we delve into the structure and function of dictionary modules, we should review the essential features of DLLs in general. Dynamic link libraries were one of the most interesting technological innovations in the original Real-mode version of Windows, and much of Windows itself is supplied in the form of DLLs. Although the original driving force behind DLLs was the efficient use of memory, DLLs have many other elegant aspects that have resulted in their propagation forward into the protected-mode Windows and OS/2 environments.

For all practical purposes, DLLs are shared subroutine libraries with *late binding*—that is, the routines in a DLL are dynamically linked to an application at its execution time, rather than being linked statically into the application when

■ Dictionary modules in Pen Windows are implemented as ordinary Windows dynamic link libraries (DLLs) and thus have the potential to be replaced by more-sophisticated products. Here's how to build a custom dictionary of your own.

its executable file is created. The allocation of memory to hold a DLL, the swapping or discarding and reloading of a DLL's segments, and the reconciliation of calls within the application to their corresponding addresses in the DLL are all managed on behalf of the application by the Windows system loader.

DLLs are built with the usual editors, high-level language compilers, resource compiler, and linker, and the structure of a DLL executable file is exactly the same as for an application executable file (the so-called "new EXE" format) except for a few flags in the .EXE header. The author of a DLL flags the routines he wants to make available to applications with the EXPORTS keyword in the module definition (.DEF) file; all other procedures in the DLL remain private and can't be accessed from the outside.

An application that uses a DLL can link to it either at load time or at runtime. In order to link to a DLL at load time, the

application's author simply references one or more of the DLL's exported routines by name in his program, and then links his application against a special LIB file (called an import library) that contains the names of all the DLL's exported routines. The linker then builds a special entry into the application's .EXE file header for each DLL and for each routine within a DLL that the application uses. When the application is launched, the system loader looks at the file header, brings all the DLLs into memory that the application needs (if they are not in memory already), and resolves the application's far calls to the DLL's routines by fixing them up with the actual memory addresses of the DLL's entry points before transferring control to the application. If any of the DLLs are missing, the loader displays an error message and refuses to launch the application.

Runtime dynamic linking is more work for the application but provides more flexibility, because it allows the application to choose whether it will continue to execute if a DLL is missing. As the first step, the application calls the Windows API function LoadLibrary() with the name of the DLL. If the DLL is not already in memory, the system loader allocates memory to hold the DLL and fetches it from the disk. The system loader then returns the DLL's "module handle" to the application. Next, the application makes successive calls to the Windows API function GetProcAddress() with the DLL module handle and the name of each DLL routine that the application needs to use. GetProcAddress() returns a far pointer to the routine's entry point, which the applica-



tion stores away in a function pointer against the time that it needs to actually use the routine.

Windows provides for multiple applications using the same DLL (or multiple instances of the same application using the same DLL) by means of reference counts and instance thunks (short pieces of code that load DS with the proper selector for the DLL's data segment). Each time an application references a DLL (either at the application's load time or by calling the `LoadLibrary()` function), Windows increments a reference count for the DLL. When a dynamic link to a DLL routine is created (again, either at the application's load time or by calling `GetProcAddress()`), Windows creates an instance thunk for the exported DLL routine.

The client application's entry to the DLL is actually via the thunk. As each application terminates, the system automatically decrements the reference counts for all of the DLLs that the application used. When the reference count for a particular DLL goes to zero, the memory occupied by the DLL is released.

Writing DLLs is not very hard, though there are a few things to note:

- Every DLL must have two routines with "magic" names for global initialization and cleanup—`LibMain()` and `WEP()`. These routines are called respectively by the system kernel when a DLL is first loaded into memory and when it is about to be unloaded from memory. The developer has a lot of latitude in what he can do in `LibMain()` and `WEP()`, except that `LibMain()` should unlock the DLL's data segment (it gets locked as a side effect of the C startup code's initialization of the local heap). `LibMain()` returns `TRUE` if initialization is successful and `FALSE` if it fails; in the latter case, Windows will refuse to load the application that referenced the DLL or return an error code for the `LoadLibrary()` function call. `WEP()` should always return `TRUE`.
- The `WEP()` routine and any interrupt handlers in the DLL must be in a fixed code segment so they will always be resident. Normally, the code segments of Windows applications and DLLs are discarded in low-memory situations and then reloaded when needed, but it would be quite inconvenient if an interrupt occurred and the segment that contained its handler had just been thrown away to make room for some other program!
- The routines that a DLL exports for use by applications must be declared as

FAR, and preferably as FAR PASCAL for symmetry with the rest of Windows.

■ Any parameters that are passed by reference from an application to a DLL routine must be passed as far pointers, because the DLL has no direct access to the application's data segment (again, DS points to the DLL's own data segment while the DLL is in control).

■ The DLL must be compiled with the `-ASw` switch so that the compiler assumes `SS != DS`, because a DLL runs on the client application's stack. Similarly, the DLL must be linked with a special runtime library (`SDLLCEW.LIB` for small model DLLs) whose routines assume that `SS != DS`.

■ The module definition file for the DLL must contain the `LIBRARY` keyword instead of the `NAME` keyword, and must list the `WEP()` routine and all the names of the routines that will be called by applications under the `EXPORTS` keyword.

For those of you with experience in OS/2 programming, there's good news and bad news: Windows DLLs are both simpler to write *and* more fragile than OS/2 DLLs. The nonpreemptive nature of Windows multitasking means you don't have to worry about reentrancy when writing a Windows DLL; the DLL will never lose control of the CPU unless it explicitly yields control.

On the other hand, since Windows runs all applications on a single Local Descriptor Table (LDT) instead of using an LDT for each application as the Intel designers intended, this means that a DLL can, maliciously or otherwise, stomp all over the memory of any other DLL or application in the system and/or corrupt the data of one client application with results that are actually intended for another. Fortunately, this glaring defect in interprocess protection will not be perpetuated in the 32-bit version of Windows.

#### THE DICTIONARY INTERFACE

A Pen Windows dictionary module is implemented as a totally conventional Windows DLL. Many different dictionaries can be active simultaneously in a Pen Windows system; in fact, an application can use as many as 16 different dictionaries at a time during handwritten input. A dictionary's entire functionality is exported through the `DictionaryProc()` function, which is called both by applications and by the Pen Windows Recognition Context Manager

(RC Manager) that we discussed in the last issue.

`DictionaryProc()` accepts six parameters on the stack, the most important of which is a command code—an integer value called *dirq*, which selects a dictionary subfunction. The remaining parameters are two far pointers, a single-precision integer, and two double-precision integers, all of which have different meanings depending on the command code. `DictionaryProc()` returns an integer value that is usually `TRUE` or `FALSE` depending on the success or failure of the requested subfunction.

The possible values of the *dirq* command code are declared as manifest constants in the `penwin.h` file and are listed in Figure 1. Some commands are issued to the dictionary by the RC Manager during the recognition process, some are sent to the dictionary by applications in order to load, select, or modify dictionary word lists, and some are requested by both. However, implementation of most of the commands is optional; the only ones that every dictionary must support are `DIRQ_OPEN`, `DIRQ_CLOSE`, `DIRQ_QUERY`, `DIRQ_STRING`, and `DIRQ_DESCRIPTION` (and even the first two of these can be "stubbed out" so they return just a success code).

Let's look at the sequence of `DictionaryProc()` calls that might occur during the execution of a typical pen-aware application that uses a dictionary such as Microsoft's `USERDICT.DLL`.

- During the application's initialization, it calls the Windows API functions `LoadLibrary()` and `GetProcAddress()` to load the dictionary module and to get the address of the `DictionaryProc()` entry point in the dictionary. An especially robust (or paranoid) application might also want to call the `DictionaryProc()` entry point with the `DIRQ_QUERY` command at this point to make sure that all of the dictionary functions it needs are supported by the dictionary it just loaded.
- Again during initialization, the application calls the `DictionaryProc()` entry point with the `DIRQ_OPEN` command code to load each word list it will be using during its execution, saving the word list handles returned by the dictionary for later use.
- Before requesting input from the user, the application fetches the RC (Recognition Context) data structure associated with the writing area (this might be an `HEDIT` or `BEDIT` control or just a region in the application's window client area) from



the RC Manager, updates the data structure with the address of the DictionaryProc() entry point and (optionally) other parameters that control recognition behavior, and then sends the modified RC structure back to the RC Manager. (A listing of the RC data structure can be found in the last column; the RC fields most closely related to the use of dictionaries are rc.lRcOptions, rc.rglpdf, rc.wTryDictionary, rc.alc, and rc.dwDictParam.)

■ The application calls the DictionaryProc() entry point with the DIRQ\_SETWORDLISTS command, passing a word list handle obtained from a previous DIRQ\_OPEN command, to select a word list to be used by the dictionary during the forthcoming

recognition process.

■ The application transfers control to the RC Manager for handwritten input, either explicitly (by a call to a Pen Windows API such as the ProcessWriting() or Recognize() functions) or implicitly (for example, by activating a dialog that contains an HEDIT or BEDIT control).

■ The RC Manager calls the recognizer to obtain and translate written input. The recognizer calls the pen device driver via the RC Manager's GetPenHwData() entry point to obtain some ink, and it then segregates the ink into individual characters or gestures called *glyphs*. The glyphs

are analyzed against the recognizer's library of character and gesture prototypes, and the recognizer then returns a symbol graph encapsulating the set of possible translations of the glyphs to the RC Manager.

■ The RC Manager calls the DictionaryProc() entry point with the DIRQ\_SYMBOLGRAPH message, passing the entire symbol graph structure, in case the dictionary wants to perform its own evaluation of the symbol graph. If the dictionary selects and returns a result string at this point, the RC Manager passes this string back to the application and the input/recognition process is ended.

■ If the dictionary ignores the DIRQ\_SYMBOLGRAPH message (as most dictionaries will), the RC Manager then "enumerates" all the possible translations of the symbol graph with the aid of the Pen Windows EnumSymbols() function, producing a series of strings in decreasing order of probability, and passing each string to the dictionary in an individual DIRQ\_STRING command. If the dictionary recognizes and accepts one of the possible translations, the string is returned to the application and the input/recognition process is ended.

■ If the dictionary rejects all of the strings resulting from the symbol graph that are presented to it in the succession of DIRQ\_STRING commands, and the flag RCO\_SUGGEST was set in the RC data structure during the third step above, the RC Manager will then call the dictionary one last time with the symbol string that was considered "most likely" by the recognizer and the command DIRQ\_SUGGEST. The dictionary is now allowed to compare the symbol string against its currently selected word list and return its best guess, which is then returned to the application. This is the place where very sophisticated pattern matching and context-sensitive recognition algorithms could be brought into play in the recognition process, hidden within the dictionary.

■ If the dictionary rejects all of the symbol strings sent to it in DIRQ\_STRING messages, and the parameter RCO\_SUGGEST is not set in the RC data structure, the RC Manager will return the string to the application that was designated as "most likely" by the recognizer. The input/recognition process is ended.

The scheme outlined above doesn't change very much if an application wants to use multiple dictionaries. The RC data structure has room for an array of up to



## DIRQ COMMANDS

| Command           | Action                                                                                                                                                                      |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DIRQ_ADD          | Tells the dictionary to add a word to the currently selected word list.                                                                                                     |
| DIRQ_CLOSE        | Signals the dictionary to close a word list, writing any changes to disk if necessary.                                                                                      |
| DIRQ_CONFIGURE    | Tells the dictionary to display a configuration dialog to the user.                                                                                                         |
| DIRQ_DELETE       | Tells the dictionary to remove a word from the currently selected word list.                                                                                                |
| DIRQ_DESCRIPTION  | Asks the dictionary to return the name of its module.                                                                                                                       |
| DIRQ_FLUSH        | Signals the dictionary to reinitialize the currently selected word list, discarding any changes.                                                                            |
| DIRQ_OPEN         | Tells the dictionary to open the specified word list and return a handle for the word list (usually called with the name of a file from which the word list can be loaded). |
| DIRQ_QUERY        | Asks the dictionary to return a TRUE or FALSE flag indicating whether the dictionary supports the specified DIRQ function.                                                  |
| DIRQ_RCCHANGE     | Signals the dictionary that a change has occurred in an RC data structure that contains the dictionary's entry point.                                                       |
| DIRQ_SETWORDLISTS | Selects a word list that was previously opened with a DIRQ_OPEN command.                                                                                                    |
| DIRQ_STRING       | Presents a string to the dictionary for matching against its currently selected word list.                                                                                  |
| DIRQ_SUGGEST      | Presents a string to the dictionary, asking for the "best guess" at a match against its currently selected word list.                                                       |
| DIRQ_SYMBOLGRAPH  | Presents an entire symbol graph, which can be enumerated into many possible strings, to the dictionary for optional matching against its currently selected word list.      |
| DIRQ_USER         | Reserved for communication between applications and custom dictionaries.                                                                                                    |

**Figure 1:** These commands, which may be sent to a dictionary by the RC Manager or application via the DictionaryProc() entry point, are used to select a dictionary subfunction.



```
// PCDICT.C The PCDICT.DLL sample Pen Windows dictionary
// module is used with DEMO5.EXE to demonstrate
// validation of user input and input completion
// by prefix matching.
// Copyright (C) 1991 Ray Duncan

#define WIN31
#define NOCOMM

#include <windows.h>
#include <penwin.h>
#include <string.h>
#include "pcdict.h"

#define cbMaxLen 256 // max string size to process

#define dim(x) (sizeof(x) / sizeof(x[0])) // returns no. of elements

char * szDesc = "PC Dictionary";

// Hardwired wordlist of state names. In a production dictionary,
// the wordlist(s) would be loaded from a file specified by the
// client application program.
//
char * States[] = {
    "Alabama",
    "Alaska",
    "Arizona",
    "Arkansas",
    "California",
    "Colorado",
    "Connecticut",
    "Delaware",
    "Florida",
    "Georgia",
    "Hawaii",
    "Idaho",
    "Illinois",
    "Indiana",
    "Iowa",
    "Kansas",
    "Kentucky",
    "Louisiana",
    "Maine",
    "Maryland",
    "Massachusetts",
    "Michigan",
    "Minnesota",
    "Mississippi",
    "Missouri",
    "Montana",
    "Nebraska",
    "Nevada",
    "New Hampshire",
    "New Jersey",
    "New Mexico",
    "New York",
    "North Carolina",
    "North Dakota",
    "Ohio",
    "Oklahoma",
    "Oregon",
    "Pennsylvania",
    "Rhode Island",
    "South Carolina",
    "South Dakota",
    "Tennessee",
    "Texas",
    "Utah",
    "Vermont",
    "Virginia",
    "Washington",
    "West Virginia",
    "Wisconsin",
    "Wyoming" };

// Table of dictionary commands supported by this DLL
// and the functions which correspond to each command.
//
struct {
    int cmd_code;
    int (*cmd_fxn)(int, LPVOID, LPVOID, int, LONG, LONG);
} commands[] = {
    DIRQ_CLOSE, DictClose,
    DIRQ_DESCRIPTION, DictDescription,
    DIRQ_OPEN, DictOpen,
    DIRQ_QUERY, DictQuery,
    DIRQ_SETWORDLISTS, DictSetWordLists,
    DIRQ_STRING, DictString,
    DIRQ_SUGGEST, DictSuggest, };

// LibMain -- Initialization routine for dynamic link library.
//
int FAR PASCAL LibMain(HANDLE hInstance, WORD wDataSeq,
    WORD wHeapSize, LPSTR lpzCmdLine)
{
    if (wHeapSize > 0)
        UnlockData(0);

    return(TRUE);
}

// WEP -- called when use count for dynamic link library has
// reached zero and library is about to be unloaded.
//
int FAR PASCAL WEP(int nParam)
{
    return(TRUE);
}

//
```

```
// DictionaryProc -- Entry point to dictionary module for
// AC Manager and client programs.
//
int FAR PASCAL DictionaryProc(int dirq, LPVOID lpIn, LPVOID lpOut,
    int cbMax, LONG lContext, LONG lData)
{
    int i;

    for(i = 0; i < dim(commands); i++)
    {
        if(dirq == commands[i].cmd_code)
            return(commands[i].cmd_fxn)(dirq, lpIn, lpOut, cbMax,
                lContext, lData);
    }
    return(FALSE);
}

// DictClose -- function to process DIRQ_CLOSE messages.
//
int DictClose(int dirq, LPVOID lpIn, LPVOID lpOut, int cbMax,
    LONG lContext, LONG lData)
{
    return(TRUE); // stubbed out for now
}

// DictDescription -- function to process DIRQ_DESCRIPTION messages.
//
int DictDescription(int dirq, LPVOID lpIn, LPVOID lpOut, int cbMax,
    LONG lContext, LONG lData)
{
    // return name of module
    _fstrncpy((LPSTR) lpOut, (LPSTR) szDesc, min(cbMax-1, sizeof(szDesc)));
    return(TRUE);
}

// DictOpen -- function to process DIRQ_OPEN messages.
//
int DictOpen(int dirq, LPVOID lpIn, LPVOID lpOut, int cbMax,
    LONG lContext, LONG lData)
{
    *(int far *) lpOut = TRUE; // set dummy wordlist handle
    return(TRUE); // return success
}

// DictQuery -- function to process DIRQ_QUERY messages.
//
int DictQuery(int dirq, LPVOID lpIn, LPVOID lpOut, int cbMax,
    LONG lContext, LONG lData)
{
    int i;

    for(i = 0; i < dim(commands); i++) // check if command supported
    {
        if(*(int far *) lpIn == commands[i].cmd_code)
            return(TRUE); // yes, found it in table
    }
    return(FALSE); // nope, not supported
}

// DictSetWordLists -- function to process DIRQ_SETWORDLISTS messages.
//
int DictSetWordLists(int dirq, LPVOID lpIn, LPVOID lpOut, int cbMax,
    LONG lContext, LONG lData)
{
    return(TRUE); // stubbed out for now
}

// DictString -- function to process DIRQ_STRING messages.
//
int DictString(int dirq, LPVOID lpIn, LPVOID lpOut, int cbMax,
    LONG lContext, LONG lData)
{
    int i;
    char InStr[cbMaxLen+1]; // receives input string

    if (lpIn) // any symbol string provided?
    {
        // translate it to char string
        SymbolToCharacter((LPSTR) lpIn, cbMaxLen, InStr, NULL);

        for (i=0; i < dim(States); i++) // perform case-insensitive
        { // match against States wordlist
            if (! _fstricmp((LPSTR) States[i], (LPSTR) InStr))
                return(CharacterToSymbol(States[i], lstrlen(States[i]), lpOut));
        }
    }
    return(FALSE);
}

// DictSuggest -- function to process DIRQ_SUGGEST messages.
//
int DictSuggest(int dirq, LPVOID lpIn, LPVOID lpOut, int cbMax,
    LONG lContext, LONG lData)
{
    int i;
    char InStr[cbMaxLen+1]; // receives input string

    if (lpIn) // any symbol string provided?
    {
        // translate it to char string
        SymbolToCharacter((LPSTR) lpIn, cbMaxLen, InStr, NULL);

        for (i=0; i < dim(States); i++) // perform prefix matching
        { // against States wordlist
            if (! _fstrnicmp(States[i], InStr, lstrlen(InStr)))
                return(CharacterToSymbol(States[i], lstrlen(States[i]), lpOut));
        }
    }
    return(FALSE);
}

//
```



**Figure 2:** This is the source code file for PCDICT.DLL, a simple Pen Windows dictionary module that can be used with the example application DEMO5.EXE (all of the PCDICT and DEMO5 source and executable files are available for downloading on PC MagNet).

16 DictionaryProc() entry points. The application puts the entry points into the RC data structure in the order that it wants the dictionaries called (of course, it is free to change this order from one hand-written input to another). The RC Manager then deals with the multiple dictionaries in a very logical way. It calls each of the dictionaries in order with the RC\_SYMBOLGRAPH message. It then calls each of the dictionaries in order with each of the DIRQ\_STRING messages; in other words, each dictionary gets a shot at a particular possible symbol string before any of the dictionaries sees the remaining possible translations of the symbol graph. Finally, if all of the dictionaries reject all of the DIRQ\_STRING commands and the RCO\_SUGGEST flag is set in the RC data structure, the RC Manager calls each of the dictionaries in order with the DIRQ\_SUGGEST message.

Dictionaries that are more sophisticated than Microsoft's USERDICT.DLL might also want to support dynamic modification of word lists; for example, a dictionary used in a word processing program ought to be able to expand its word list to include terms that are specific to the user's profession. The interface for this is the DIRQ\_ADD command, which an application calls to add a new word to a word list, and DIRQ\_DELETE, which an

application calls to delete a word. The application can then send the DIRQ\_CLOSE command to the dictionary to tell it to write the modified word list out to disk, or the dictionary can write the word list during execution of its WEP() routine before it is unloaded from memory.

#### AN EXAMPLE DICTIONARY DLL

In order to make these concepts a bit more concrete and give you some source code you can easily try out interactively and then trace with the CodeView debugger, I've written a simple Pen Windows dictionary called PCDICT.DLL. The C source code for the dictionary, PCDICT.C, is listed in Figure 2. The module definition file PCDICT.DEF, which defines the DLL module name, segment attributes, heap size, and other important characteristics for the linker, is shown in Figure 3. The header file for the dictionary, PCDICT.H is shown in Figure 4.

The source code for the interactive example program that uses PCDICT.DLL, called DEMO5.EXE, is not published here for space reasons, but it is nearly identical to the DEMO4.EXE program whose source listing was published in the last installment of this column. All of the source files and executable files for both

overreaction, I designed PCDICT.DLL so that the DictionaryProc() routine is nothing more than a short table-driven dispatcher.

The DIRQ commands supported by PCDICT.DLL and the corresponding functions that implement the commands are listed in the struct{} called commands{}. This incidentally makes the job of the DIRQ\_QUERY function almost trivial; it simply searches the commands{} table to see whether the requested command is present or not! This setup also makes modification and testing of the dictionary module a very easy job, because each command processing function works in complete isolation from the others.

In order to keep the source code short and skeletal, some of the functions are stubbed out to return a success code, and the function that processes the DIRQ\_STRING command merely performs a case-insensitive comparison against a static table of strings that is hard-wired into the source code.

I did borrow a nifty idea for *prefix matching* in the DIRQ\_SUGGEST function from Microsoft's CUSTDICT.DLL, however. Prefix matching can be used together with context sensitivity in situations where the number of valid user inputs is quite limited to dramatically improve accuracy and decrease the user's work. If the user enters just a few letters, and those letters match the beginning of a string in the word list, the DIRQ\_SUGGEST function returns the entire string. For example, in a field where the only valid input is the name of a state, a user might enter *Ca*, *ca*, or *CA* and get back the string *California*.

If you feel ambitious, you might want to change PCDICT.DLL to support more-sophisticated string matching by enhancing the functions that process the DIRQ\_STRING and DIRQ\_SUGGEST commands. You might also want to make PCDICT.DLL more flexible by adding code to read word lists from disk and select a word list in the functions that process the DIRQ\_OPEN and DIRQ\_SETWORDLISTS commands.

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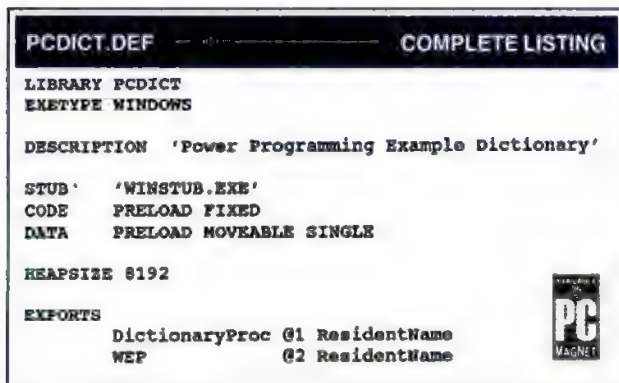


Figure 3: This is the module definition file for PCDICT.DLL.

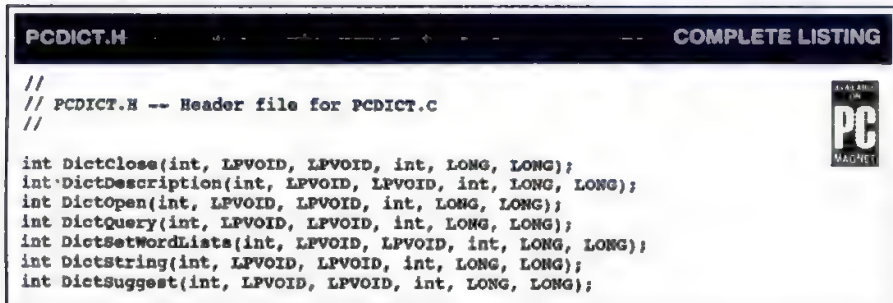


Figure 4: This is the C language header file for PCDICT.C.



by  
Sal Ricciardi

# Databases

## QUIT OR JUMP TO DOS

I like to include the two SET KEY procedures shown in Figure 1 in my *Clipper* programs. The DOQUIT procedure lets you QUIT a program by simply pressing Alt-X. The other procedure, DOSSHELL, lets you shell to DOS with Alt-E.

The calling program must create a variable called StartColor (which determines the color used when shelling to DOS), and it must bind the DOSSHELL and DOQUIT procedures to their respective key combinations with the SET KEY command. Once these things have been done, Alt-E will activate DOSSHELL, and Alt-X will activate DOQUIT from any wait state in the program.

The two procedures can be placed in the main program file. However, I prefer to place them in a separate procedure file (such as PROCS.PRG) and then include a SET PROCEDURE TO command at the start of my program (for example, SET PROCEDURE TO PROCS).

When you hit the Alt-X key combination, a menu appears, giving you an op-

■ **QUIT OR JUMP TO DOS:**  
Let your application jump to DOS or quit at the touch of a key, using these *Clipper* procedures.

portunity to change your mind and not quit. If you decide not to quit, the screen is restored, and your program continues where it left off. While the DOQUIT procedure is running, the Alt-X key is temporarily disabled to prevent recursive calls to the procedure. If the Quit option is not chosen, the Alt-X key is reenabled.

The DOSSHELL procedure first saves the entire screen and then instructs the user to type EXIT when he's ready to return to the program. The SETCURSOR(1) line is necessary in case you hit Alt-E while the cursor is disabled. It makes sure there's a cursor available when you

jump to DOS. When you return from DOS, the colors are reset and the screen is restored.

Neil Irwin  
Guelph, Ontario, Canada



I modified the DOQUIT procedure, shown in Figure 1, to center its menu automatically, based on the number of rows and columns available on the display. I also added a few lines to both procedures to save and restore the cursor position.

The TRYALT program, shown in Figure 2, demonstrates how to set up the calling program for use with these procedures. The first three lines create the required StartColor variable, assign the Alt-X key to DOQUIT, and assign the Alt-E key to DOSSHELL, respectively.

Both of these routines can be useful additions to your applications, provided you use them with care. Since there are times when you would not want the user to quit or shell to DOS, such as right in the middle of a batch update or within a

### DOQUIT AND DOSSHELL

```
.....
* PROCEDURE DOQUIT                               Clipper 5.0
* SET KEY procedure to QUIT an application
.....
PROCEDURE DOQUIT (ProcName, ProcLine, ProcVar)
LOCAL OldRow, OldCol, Scol, Srow, OldCursor
OldRow = ROW()
OldCol = COL()
Scol = (MAXCOL() - 33) / 2

Srow = (MAXROW() - 6) / 2
OldScreen = ;
  SAVESCREEN(Srow, Scol, Srow + 6, Scol + 33)
OldColor = SETCOLOR("GR/B")

OldCursor = SETCURSOR(0)
@ Srow, Scol CLEAR TO Srow + 6, Scol + 33
@ Srow, Scol TO Srow + 6, Scol + 33 DOUBLE
@ Srow + 2, Scol + 2 SAY ;
  "Are you sure you want to quit?"
@ Srow + 4, Scol + 9 PROMPT " Yes "
@ Srow + 4, Scol + 19 PROMPT " No "
SET KEY 381 TO
TONE(1500,1)
TONE(2000,1)
MENU TO Choice
SETCURSOR(OldCursor)
IF Choice = 1
  CLOSE ALL
  SETCOLOR(StartColor)
  CLS
  QUIT
ENDIF
SET KEY 381 TO DOQUIT
```

```
SETCOLOR(OldColor)
RESTSCREEN(Srow, Scol, Srow + 6, ;
  Scol + 33, OldScreen)

SETPOS(OldRow, OldCol)
RETURN

.....
* PROCEDURE DOSSHELL                               Clipper 5.0
* SET KEY procedure to SHELL to DOS
.....
PROCEDURE DOSSHELL (ProcName, ProcLine, ProcVar)
LOCAL OldCursor, OldRow, OldCol
OldScreen = SAVESCREEN(0, 0, MAXROW(), MAXCOL())
OldCursor = SETCURSOR(1)

OldColor = SETCOLOR(StartColor)

OldRow = ROW()
OldCol = COL()
CLS
@ 0,0 SAY "Type EXIT to return to the program"
?
ComSpec = GETENV("COMSPEC")

RUN (ComSpec)
SETCOLOR(OldColor)
RESTSCREEN(0, 0, MAXROW(), MAXCOL(), OldScreen)
SETCURSOR(OldCursor)
SETPOS(OldRow, OldCol)
position
RETURN

.....
** Restore the color
**
** Restore the area of
** the screen
** Restore the cursor
** position under the box
.....
** Make some locals
** Saves the entire screen
** Set the cursor. Needed if
** shelling from a menu
** Save current colors and
** set new colors
** Save cursor row
** and column
**
** Tell the user how to
** return to this program
** Get the COMSPEC
** environment variable
** Run COMMAND.COM
** Restore the colors
** Restore the screen
** Restore the cursor
** Restore the cursor
```



Figure 1: The DOQUIT and DOSSHELL SET KEY procedures let you quit your *Clipper* application or shell to DOS at the touch of a key.



TRYALT.PRG

COMPLETE LISTING

```
*****
* TRYALT.PRG                               Clipper 5.0
* Test program to try the DOSSHELL and DOQUIT SET KEY procedures
*****
SET PROCEDURE TO TRYALT
StartColor = SETCOLOR()           ** Save the existing colors
SET KEY 301 TO DOQUIT              ** Bind the Alt-X key to the DOQUIT procedure
SET KEY 274 TO DOSSHELL            ** Bind the Alt-E key to the DOSSHELL procedure
CLS
SETCOLOR("W/R")
pcmag = "PC Magazine Databases PC Magazine Databases PC Magazine Databases PC
Magazine "
single =
CHR(218)+CHR(196)+CHR(191)+CHR(179)+CHR(217)+CHR(196)+CHR(192)+CHR(179)
@ 0,0,24,79 BOX single+"x"
i = 1
DO WHILE i <= 23
  @ i, 1 SAY pcmag
  i = i + 1
ENDDO
SETCOLOR(StartColor)
WAIT ""                            ** Hit Alt-X or Alt-E while waiting
RETURN
```



**Figure 2:** The TRYALT program demonstrates how to call the DOQUIT or DOSSHELL procedure from your application.

critical SCAN-ENDSCAN operation, you should disable access to DOQUIT and DOSSHELL prior to entering such critical sections of your code. You can then reenale access to the routines afterward.

For example, one approach would look like this:

```
SET KEY 301 TO
SET KEY 274 TO

BatchUpdate()

SET KEY 301 TO DOQUIT
SET KEY 274 TO DOSSHELL
```

This disables Alt-E and Alt-X prior to running a hypothetical batch update function.

Another alternative would be to add state variables to your main program and check the state variables between DOQUIT and DOSSHELL. For example, to employ this approach with DOQUIT, you could add a logical state variable called OKQuit to your main program, set it to .T. if access is allowed, .F. if it is not, and then insert the following lines after the LOCAL line in DOQUIT:

```
IF (!OKQuit)
  RETURN
ENDIF
```

In this manner preventing access to DOQUIT is a simple matter of setting

OKQuit to .F., as in:

```
OKQuit = .F.    ** Disallow

BatchUpdate()

OKQuit = .T.    ** Allow
```

Depending on your application, you may also want to add additional code to DOQUIT once you've incorporated it into your program, to properly close down that application. Note that DOQUIT issues a CLOSE ALL and clears the screen before quitting.

DOSSHELL will not work correctly if there isn't enough memory available for the RUN command to load COMMAND.COM or if the COMSPEC environment variable isn't set correctly.

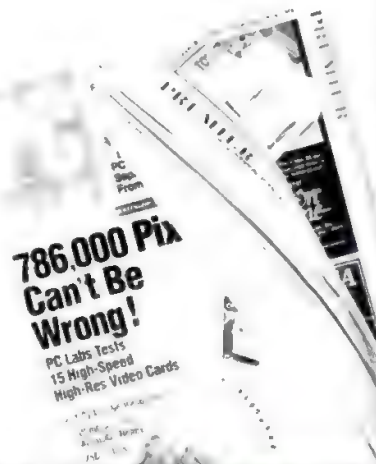
DOQUIT, DOSSHELL, and the TRYALT program are available on PC MagNet in TRYALT.ZIP.

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edited by  
Sharon Terdeman

# Languages

## COLOR TEXT PRINTING IN QUICKBASIC

Although QuickBASIC has very good support for EGA and VGA graphics, one feature notably absent is the ability to specify both foreground and background colors for text when in graphics mode.

Normally, the current foreground COLOR setting is used, but the background is always black. Even though the PALETTE statement can be used to change the background color, the new color affects all of the text on-screen, even text that has already been printed.

To solve this problem I wrote the Col-

**COLOR TEXT PRINTING IN QUICKBASIC: A handy program lets you specify foreground and background text colors while in graphics mode.**

orPrint subprogram shown in Figure 1. ColorPrint uses QuickBASIC's CALL InterruptX routine, which lets a program access DOS and BIOS services directly.

The routine first prints a CHR\$(219) solid block character in the specified background color, and then uses the BIOS service's XOR function to overwrite the appropriate characters on top of the colored background.

Joseph E. Cates  
Fort Deposit, Alabama



This is a terrific idea that solves a long-standing problem. When you use the BASIC PRINT command in graphics mode, BASIC simply calls the routines built into the PC's BIOS to place the text on-screen at the specified location. Unfortunately, the BIOS routines are not very sophisticated and only accept a foreground color. Unless the EGA/VGA palette is changed, the background color is always black.

There are some points worth noting, though. First, ColorPrint requires an EGA or VGA adapter, since CGA displays cannot show more than four colors at one time. Also, adapting this routine to work with Microsoft's newest BASIC 7.1 compiler requires changing the two occurrences of VARSEG to SSEG. Because BASIC 7.x can optionally store strings in far memory, you need SSEG to indicate the segment where the data is located.

The interrupt routine is provided in the QB.QLB and QB.LIB files with QuickBASIC, and QBX.QLB and QBX.LIB with BASIC 7.x. To start QuickBASIC and load the appropriate library, enter QB /L; for BASIC 7.x, enter QBX /L instead. The QB.BI and QBX.BI (BASIC Include) files are also provided by Microsoft and contain code that defines the RegTypeX TYPE variable.—Ethan Winer

## SPEAK YOUR LANGUAGE

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### CLRPRINT.BAS ————— COMPLETE LISTING

```
'CLRPRINT.BAS - graphics printing routine accepts a background color
'$INCLUDE: 'QB.BI' 'this defines the RegTypeX TYPE variable

DECLARE SUB ColorPrint (text$, row%, col%, fc%, bc%)
DIM SHARED Registers AS RegTypeX

SCREEN 9

FOR i = 9 TO 219 STEP 10 'draw ellipses to show it's graphics mode
  clr = Chr + 1
  CIRCLE (310, i), i, clr MOD 16, , , .6
NEXT

CALL ColorPrint(" ColorPrint - Microsoft QuickBasic ", 3, 23, 4, 7)
CALL ColorPrint(" Graphics text with a background color!", 5, 20, 7, 1)

FOR bc% = 0 TO 15 'display all possible color combinations
  FOR fc% = 0 TO 15
    CALL ColorPrint(HEX$(fc%), 8 + bc%, 32 + fc%, fc%, bc%)
  NEXT
NEXT

SUB ColorPrint (text$, row%, col%, fc%, bc%) STATIC

  c$ = STRING$(LEN(text$), 219) 'create a string of solid characters

  Registers.ax = &H1300 'video service 13h, subfunction 0
  Registers.bx = bc% 'BH = page (0), BL = color
  Registers.cx = LEN(text$) 'CX = string length
  Registers.dx = 256 * (row% - 1) + (col% - 1) 'DH = row, DL = column
  Registers.es = VARSEG(c$) 'ES = string data segment
  Registers.bp = SADD(c$) 'BP = string address
  CALL InterruptX(&H10, Registers, Registers) 'call the BIOS to print it

  Registers.bx = (fc% XOR bc%) + &H80 'BL = color, +&H80 means use XOR
  Registers.es = VARSEG(text$) 'ES = string data segment
  Registers.bp = SADD(text$) 'BP is the string address
  CALL InterruptX(&H10, Registers, Registers) 'call the BIOS

END SUB
```

**Figure 1:** This short subprogram lets BASIC users specify both foreground and background colors when printing text in graphics mode.

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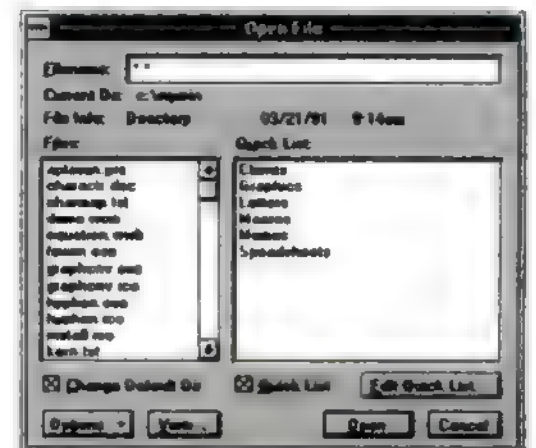


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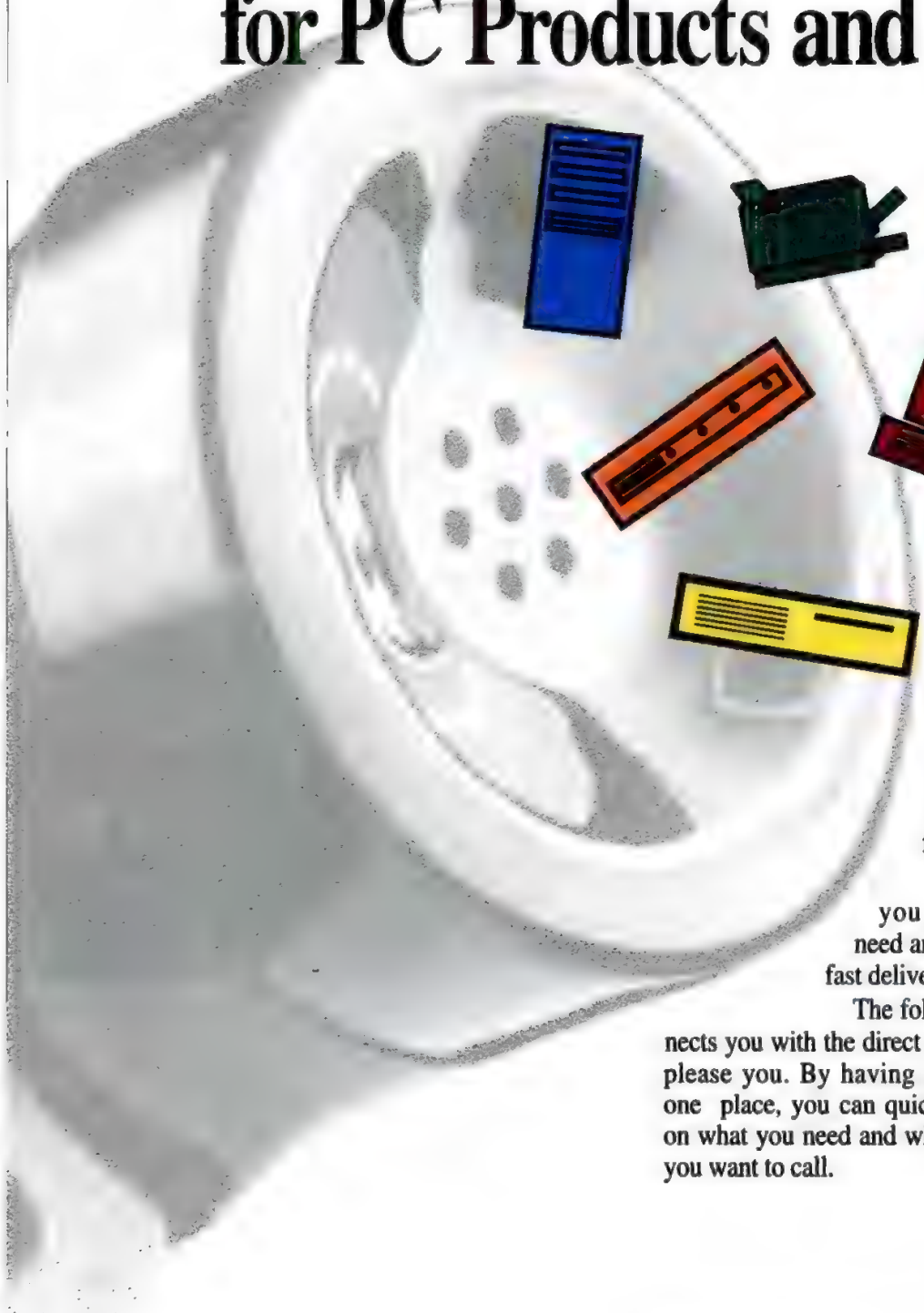
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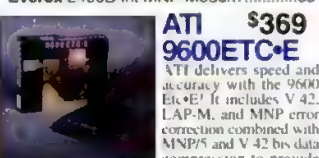
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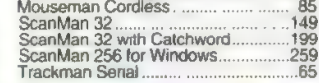
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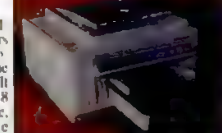
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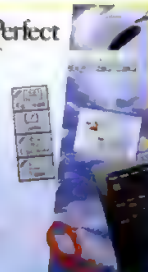


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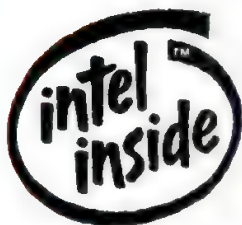


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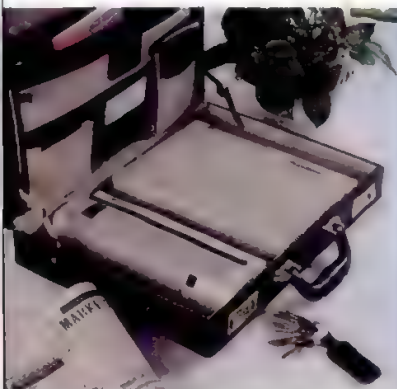
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| MODEL#                                      | AMT. UPGRADED | AST PART#      | PRICE  |
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| Premium 386/33                              | 1Meg          | 500718-002     | 69 00  |
| Premium II                                  | 1Meg          | 500780-003 WPB | 85 00  |
| 386SX20, 486-25, 25E, 33                    | 4Meg          | 500780-004 WPB | 219 00 |
| Premium Tower, 386/33TE, 486/25TE, 486/33TE | 8Meg          | 500780-001 WPB | 418 00 |

## ZENITH MEMORY UPGRADES

| MODEL#               | AMT. UPGRADED | ZENITH PART#    | PRICE  |
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| Z386/33, 25, 20      | 1Meg          | ZA3800ME        | 69 00  |
| Z386/33, 25, 20      | 4Meg          | ZA3800MK        | 229 00 |
| Z248, Z286LP, Z386SX | 2Meg          | Z-605-1 modules | 109 00 |

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| 30F5348 (512K)                | 30-286                                                  | 35 00                     |
| 30F5360 (2Meg)                | 30-286, 50 MTHR 8D                                      | 105 00                    |
| 6450375 (1Meg)                | 80-041                                                  | 65 00                     |
| 6450379 (2Meg)                | 80-111, 311                                             | 119 00                    |
| 6451060 (4Meg)                | 80-A21, A-61, 80-A31, 80-111, 80-311                    | 219 00                    |
| 6450603 (1Meg)                | 35SX, 40SX, 55SX, Model 70's, P-70                      | 65 00                     |
| 6450604 (2Meg)                | 35SX, 40SX, 50Z, 55SX, 55LS, Model 70-E, 061, 121, P-70 | 95 00                     |
| 6450608 (2Meg)                | 70-A21, A-61, B-21, B-61                                | 104 00                    |
| 78X8955 (128K)                | 25                                                      | 35 00                     |
| 34F2933 (4Meg)                | 35SX, 40SX, 55SX, 65SX                                  | 189 00                    |
| 87F9977 (4Meg)                | 55SX, 55LS, 65SX, 40SX, 35SX, 35LS                      | 189 00                    |
| 1383679 (512K), (2Meg)        | P/S1                                                    | 50 00, 119 00             |
| 6450902 (2Meg)                | 57SX, 90, 95, P-75                                      | 115 00                    |
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| 486/25, 486/33L         | 8Meg Module   | 116581-001 | 399 00 |
| 486/50L                 | 32Meg Module  | —          | CALL   |
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| DeskPro 386/25, 386/20  | 1Meg Module   | 113131-001 | 75 00  |
|                         | 4Meg Module   | 113132-001 | 189 00 |
| DeskPro 386S-16MHz      | 1Meg Exp Bd   | 113633-001 | 120 00 |
|                         | 4Meg Exp Bd   | 113634-001 | 259 00 |
|                         | 1Meg Module   | 113646-001 | 75 00  |
|                         | 4Meg Module   | 112534-001 | 199 00 |
| DeskPro 386/20E         | 1Meg Exp Bd   | 113644-001 | 119 00 |
| DeskPro 386/25E         | 4Meg Exp Bd   | 113645-001 | 259 00 |
|                         | 1Meg Module   | 113131-001 | 75 00  |
|                         | 4Meg Module   | 113132-001 | 189 00 |
| DeskPro 286N            | 1Meg Module   | 118688-001 | 64 00  |
| 386N, 386SX20           | 2Meg Module   | 118689-001 | 99 00  |
|                         | 4Meg Module   | 118690-001 | 199 00 |
| DeskPro 386/16          | 1Meg Kit      | 108071-001 | 119 00 |
|                         | 4Meg Kit      | 108072-001 | 269 00 |
|                         | 1-2Meg Exp Bd | 108069-001 | 309 00 |
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|                     | 4Meg Exp Bd   | 107653-001 | 479 00 |
|                     | 4Meg Daght Bd | 107654-001 | 479 00 |
| Portable III        | 2Meg Kit      | 107332-001 | 119 00 |
| Compaq SLT/286      | 1Meg Module   | 110235-001 | 119 00 |
|                     | 4Meg Module   | 110237-001 | 409 00 |
| Compaq SLT/386      | 1Meg Module   | 118303-001 | 109 00 |
|                     | 2Meg Module   | 118304-001 | 179 00 |
|                     | 4Meg Module   | 118305-001 | 359 00 |
| Compaq Lite 286     | 1Meg Bd       | 117081-001 | 79 00  |
|                     | 2Meg Bd       | 117081-002 | 119 00 |
|                     | 4Meg Bd       | 117081-003 | 219 00 |
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| T2000/T2000SX   | 1Meg         | PC18-PA8316U   | 114 00                    |
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| T4400SX         | 2Meg         | PC-PA2003U     | 249 00                    |
| T4400SX         | 4Meg         | PC-PA2004U     | 349 00                    |
| T4400SX         | 8Meg         | PC-PA2005U     | 799 00                    |
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| T3200SX         | 4Meg         | PC12-PA8909    | 179 00                    |
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| T3200SXC        | 4Meg         | PC19-PA8319U   | 199 00                    |
| T5100           | 2Meg         | PC7-PA8301U    | 114 00                    |
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| T5200/T8500     | 8Meg         | PC10-PA8313U   | 399 00                    |

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| NEC Prospeed 386            | 2Meg       | PC31-22                    | 779 00         |
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| Panasonic 4450         | \$135 | —     | —     | —     | —     | —              |
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| OKi 800, 840           | CALL  | CALL  | CALL  | —     | —     | —              |
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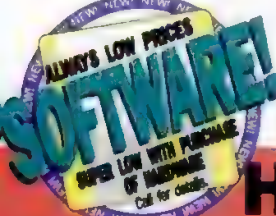
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| Panasonic CF270,       |        |
| 16 MHz, 60 MG, VGA ..  | \$1799 |
| Panasonic CF370H6      |        |
| 386SX-20, 60MG, VGA .. | \$2499 |

## TEXAS INST.

|                     |        |
|---------------------|--------|
| TM 2000/20 MG ..... | \$969  |
| TM 2000/40 MG ..... | \$1199 |
| TM 3000/40 MG ..... | \$1899 |
| TM 3000/60 MG ..... | \$2249 |
| TM 3000/WINSX 60 .. | \$2559 |
| TM 3000/WINSX 80 .. | \$2895 |
| LASER STD .....     | \$879  |
| LASER PS17 .....    | \$1199 |
| LASER PS35 .....    | \$1499 |

## SOFTWARE

|                           |             |
|---------------------------|-------------|
| Aldus Pagemaker .....     | \$489       |
| Corel Draw .....          | \$369       |
| Harvard Graphics 3.0 ..   | \$389       |
| Lotus 123 2.2/3.1 ..      | \$329/\$389 |
| Microsoft Mouse .....     | \$89        |
| Microsoft Excel .....     | \$299       |
| Microsoft Windows 3.0 ..  | \$79        |
| Microsoft DOS 5.0 .....   | \$79        |
| Ventura Desktop Publ. ... | \$499       |
| Word Perfect 5.1 .....    | \$245       |

## SCAN. & DIGIT.

|                         |       |
|-------------------------|-------|
| Epson ES300C .....      | \$999 |
| Kurta XLP .....         | \$249 |
| Logitech ScanMan .....  | \$159 |
| Panasonic FXRS 3070U .. | \$769 |
| Summasketch 12x12 ..... | \$295 |
| Summasketch 12x18 ..... | \$539 |

## MULTIFUNCTION BOARDS

|                          |       |
|--------------------------|-------|
| AST 6 Pack w/384K .....  | \$159 |
| Irma Board III .....     | \$399 |
| AST 5251-II Plus .....   | \$449 |
| Sound Blaster PROF ..... | \$189 |



|                            |       |
|----------------------------|-------|
| Intel Above Board+ .....   | \$269 |
| Intel Plus 8 w/2 MG .....  | \$389 |
| Intel 386 PC w/1 MG .....  | \$459 |
| Intel Satisfaction .....   | \$359 |
| Intel Scanner Option ..... | \$199 |
| Intel Snap-In 386 .....    | \$359 |

## DRIVES & TAPES

|                           |       |
|---------------------------|-------|
| Ext. 1.2 for PSII .....   | \$159 |
| Toshiba 3 1/2" 720K ..... | \$69  |
| Toshiba 3 1/2" 1.44 ..... | \$69  |
| Colorado Jumbo 120 .....  | \$209 |
| Colorado Jumbo 250 .....  | \$269 |
| Everex 40 MB Tape .....   | \$209 |
| NEC CDR-73 .....          | \$579 |

## SEAGATE HARD DISKS

|                            |       |
|----------------------------|-------|
| 48 MB 3 1/2" (157N-Kit) .. | \$259 |
| 40 MB (157A) .....         | \$169 |
| 40 MB for AT (ST251-1) ..  | \$239 |
| 80 MB for AT (4096) .....  | \$399 |
| 80 MG 296 Kit .....        | \$299 |
| 89 MG 3096 .....           | \$279 |
| 106 MG 3120A .....         | \$369 |
| 120 MG 3144A .....         | \$379 |
| 211 MG 1239 .....          | \$569 |

## IOMEGA

|                           |       |
|---------------------------|-------|
| 90 MB Int. w/boot card .. | \$979 |
| 90 MB Ext. w/boot card .. | \$999 |

## PLUS

|                        |       |
|------------------------|-------|
| Hard Card 40 MB .....  | \$549 |
| Hard Card 50 XL .....  | \$299 |
| Hard Card 80 MB .....  | \$419 |
| Hard Card 105 MB ..... | \$449 |

## CONNOR HARD DRIVES

|              |       |
|--------------|-------|
| 40 MB .....  | \$199 |
| 120 MB ..... | \$359 |
| 200 MB ..... | \$589 |

## MODEMS

|                            |       |
|----------------------------|-------|
| Dove Fax Modem DOS ..      | \$179 |
| Dove Fax Windows .....     | \$209 |
| Hayes Pocket 2400 .....    | \$119 |
| Hayes 2400 Ext. ....       | \$299 |
| Hayes Optima 96 .....      | \$379 |
| Hayes Ultra 96 .....       | \$599 |
| Hayes Ultra 96 14.4 .....  | \$759 |
| Intel 2400 .....           | \$139 |
| Intel 2400 Ext. ....       | \$159 |
| Intel 2400 Ext. MNP .....  | \$209 |
| Intel 9600 Ext. ....       | \$439 |
| Intel 9600 14.4 Ext. ....  | \$479 |
| Mghtz 2400 Tosh/CPQ ..     | \$129 |
| Practical Per 9600 .....   | \$409 |
| Everex 2400 .....          | \$79  |
| Everex 2400 External ..... | \$169 |
| US Robotics 9600 .....     | \$569 |
| US Robotics Dual Std ..    | \$779 |

## CHIPS

|                        |           |
|------------------------|-----------|
| 256K/1 MG Chips. each  | \$3/\$6   |
| 256 x 4 Chips. ....    | \$6       |
| 256K/1MB Simms .....   | \$15/\$49 |
| 4MB Simms .....        | \$159     |
| Compaq 386 4 MB .....  | \$239     |
| Compaq SLT 2 MB .....  | \$239     |
| Compaq LTE 2MB .....   | \$159     |
| Compaq LTE 386 4MB ..  | \$349     |
| HP 2MG Upgrade .....   | \$119     |
| IBM 2-8 MG Board ..... | \$279     |
| IBM 70 & 80 2 MB ..... | \$119     |
| IBM 70 & 80 4 MB ..... | \$219     |
| OKI Laser 2MB .....    | \$149     |



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|----------------------|-------|
| Intel 8087-2 .....   | \$109 |
| 80287-10XL/XLT ..... | \$89  |
| 80387-16 .....       | \$195 |
| 80387 SX-16 .....    | \$129 |
| 80387 SX-20 .....    | \$135 |
| 80387-20/25/33 ..... | \$195 |
| 80487 SX .....       | \$449 |

## NETWORKING

|                            |             |
|----------------------------|-------------|
| Netware 2.2 5 User .....   | \$499       |
| Netware 2.2 10 User ...    | \$1099      |
| Netware 2.2 50 User ...    | \$1999      |
| Lantastic 10BPS Starter .. | \$469       |
| E143 Ethernet .....        | \$209       |
| NE1000 Ethernet .....      | \$139       |
| NE2000 .....               | \$159       |
| Ethercard +/16 .....       | \$139/\$165 |
| EtherLink II 3 Com .....   | \$185       |
| IBM Token Ring .....       | \$599       |

## VIDEO BOARDS

|                           |       |
|---------------------------|-------|
| ATI VGA Wonder XL .....   | \$179 |
| ATI VGA Wonder 512 .....  | \$199 |
| ATI 8514 1MG .....        | \$419 |
| ATI Graph Ultra 1MG ..... | \$499 |
| Boca Super VGA .....      | \$129 |
| 1024 VGA 16 Bit .....     | \$79  |
| NEC Grph Engine 256 ..... | \$849 |
| Orchid Pro II 1MG .....   | \$269 |
| Orchid Fahrenheit 1MG ..  | \$329 |
| Paradise VGA 1024 .....   | \$139 |
| Paradise +16 .....        | \$129 |

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### MITSUBISHI

|                    |        |
|--------------------|--------|
| EGA .....          | \$249  |
| VGA XC1429 .....   | \$379  |
| Diamond Scan ..... | \$489  |
| HL6615 16" .....   | \$969  |
| HL6945 20" .....   | \$1789 |

### NEC

|                    |             |
|--------------------|-------------|
| 3 FGX/4 FGX .....  | \$639/\$749 |
| 5 FGX .....        | \$1349      |
| Multisync VD ..... | \$1999      |

### PANASONIC

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|--------------------------|--------|
| 1381 VGA 1024x768 .....  | \$329  |
| 1395 VGA 1024x768 .....  | \$439  |
| 1991 VGA 1280x1024 ..... | \$1559 |

### GOLDSTAR

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|----------------------------------------------|---------|------------|-------|
| PS/1                                         | 2MB     | IBM PN N/A | \$119 |
| PS/2 30/286                                  | 1497259 |            |       |
| 2MB Kit                                      | 30F5360 |            | \$109 |
| PS/2 35SX/LS, 40SX/50Z, 55SX/LS, 65SX/LS, 70 |         |            |       |
| 1MB                                          | 6450003 |            | \$59  |
| 2MB                                          | 6450604 |            | \$119 |
| PS/2 70-A21/A61/B21/B61                      |         |            |       |
| 2MB                                          | 6450608 |            | \$129 |
| PS/2 35SX/LS, 40SX/50Z, 55SX/LS, 65SX/LS, 70 |         |            |       |
| 4MB                                          | 34F2933 |            | \$269 |
| PS/2 35SX/LS, 40SX                           |         |            |       |
| 8MB                                          | 6450129 |            | \$589 |
| PS/2 57SX, 90, 95                            |         |            |       |
| 8MB                                          | 6450130 |            | \$509 |
| PS/2 80-141                                  |         |            |       |
| 1MB                                          | 6450375 |            | \$79  |
| PS/2 80-111/311                              |         |            |       |
| 2MB                                          | 6450379 |            | \$139 |
| PS/2 90, 95 and P75 (install in pairs)       |         |            |       |
| 2MB                                          | 6450902 |            | \$119 |
| 4MB                                          | 6450128 |            | \$209 |
| Expansion boards for all models 50 and 60    |         |            |       |
| 2-8MB w/2MB                                  | 1497259 |            | \$319 |
| 2-16MB w/2M                                  | 6450609 |            | \$339 |
| Expansion boards for all models 70 and 80    |         |            |       |
| 2-14MB w/2M                                  | 34F3077 |            | \$349 |
| 4-16MB w/4M                                  | 34F3011 |            | \$459 |

## NEC MEMORY

|                   |             |  |       |
|-------------------|-------------|--|-------|
| Powernote SX      |             |  |       |
| 2MB Brd           | APC-H855    |  | \$499 |
| 4MB Brd           | APC-H853    |  | \$729 |
| Powernote SX Plus |             |  |       |
| 1-2MB Brd         | APC-H850E   |  | \$239 |
| 4-8MB Brd         | APC-852E    |  | \$629 |
| Powernote SX/20   |             |  |       |
| 2MB CPU           | OP-410-8101 |  | \$199 |
| 2MB Brd           | OP-410-8102 |  | \$239 |
| Powernote 386/20  |             |  |       |
| 2MB               | APC-H655E   |  | \$359 |
| Powernote 386/25  |             |  |       |
| 2MB               | APC-H655X   |  | \$369 |
| Powernote 386/258 |             |  |       |
| 4MB Kit           | OP-410-5201 |  | \$199 |

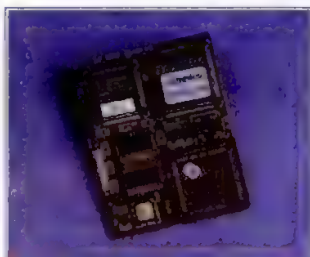
## HP MEMORY

|                                                |             |  |       |
|------------------------------------------------|-------------|--|-------|
| Vectra GS/168, 20PC, R3/20PC, 25PC, 20C        |             |  |       |
| 1MB Kit                                        | D1540/1640A |  | \$69  |
| 4MB Kit                                        | D1542/1642A |  | \$199 |
| Vectra 386/16M, 386/20N                        |             |  |       |
| 2MB                                            | D2406A      |  | \$159 |
| 8MB                                            | D2404A      |  | \$609 |
| Vectra 486 PC (Install in Pairs)               |             |  |       |
| 1MB                                            | D2150A      |  | \$69  |
| 4MB                                            | D2151A      |  | \$299 |
| Vectra 386/25, 486/25T, 33T (Install in Pairs) |             |  |       |
| 2MB                                            | D2381A      |  | \$129 |
| Vectra 486PC and 386/25 PC                     |             |  |       |
| 4MB                                            |             |  | \$549 |

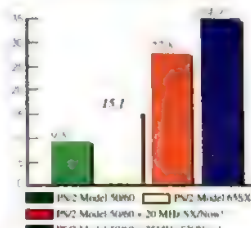
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## PRINTER MEMORY

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|---------------------------------------------|--------------|--|-------|
| Hewlett-Packard LaserJet HP, III, IIIP, IID |              |  |       |
| 2MB                                         | 334758       |  | \$125 |
| 4MB                                         | 334778       |  | \$199 |
| Hewlett-Packard LaserJet II and IID         |              |  |       |
| 2MB                                         | 334448       |  | \$125 |
| 4MB                                         | 334458       |  | \$195 |
| Hewlett-Packard DeskJet 500 and Plus        |              |  |       |
| 256K                                        | 227078       |  | \$99  |
| IBM Laser 4019 and 4019e                    |              |  |       |
| 2MB                                         | 1039137      |  | \$149 |
| 3.5MB                                       | 1038675      |  | \$219 |
| IBM Laser 4029 All Models                   |              |  |       |
| 2MB                                         | 1183334      |  | \$179 |
| 4MB                                         | 1183335      |  | \$359 |
| Canon LBP-4                                 |              |  |       |
| 2MB                                         | PN N/A       |  | \$249 |
| Brother HL-8, BE                            |              |  |       |
| 2MB                                         | MB-820       |  | \$199 |
| Panasonic 4450I and 4420                    |              |  |       |
| 2MB                                         | KX-P441      |  | \$149 |
| 4MB                                         | PN N/A       |  | \$239 |
| Toshiba Page Laser 6                        |              |  |       |
| 4MB                                         | LS6-NB0100   |  | \$219 |
| OKI Laser 400                               |              |  |       |
| 1MB                                         | 70014701     |  | \$99  |
| 2MB                                         | OKI PN N/A   |  | \$129 |
| Texas Instruments MicroLaser and XL         |              |  |       |
| 1MB                                         | 2555739-0001 |  | \$79  |
| Epson EPL 6000                              |              |  |       |
| 2MB                                         | IBS401       |  | \$149 |

## SIMM / DRAM

| SIMMS AND SIPPS | DRAM CHIPS |
|-----------------|------------|
| 4MX9-80         | \$169      |
| 1MX9-80         | \$48       |
| 256X9-80        | \$15       |
| 1X1-80          | \$4.50     |
| 256X4-80        | \$5.00     |
| 256X1-80        | \$1.80     |

## COMPAQ MEMORY

|                                                                                    |            |  |       |
|------------------------------------------------------------------------------------|------------|--|-------|
| DeskPro 386-20, 20E and 25                                                         |            |  |       |
| 1MB                                                                                | 113131-001 |  | \$89  |
| 4MB                                                                                | 113132-001 |  | \$219 |
| DeskPro 386S/16                                                                    |            |  |       |
| 1MB                                                                                | 113646-001 |  | \$89  |
| 4MB                                                                                | 112534-001 |  | \$219 |
| DeskPro 286N, 386N, 386SX/20, 25M, 486/33M, 486S/25M, 16M; SystemPro LT, Port 486c |            |  |       |
| 1MB                                                                                | 118688-001 |  | \$69  |
| 2MB                                                                                | 118689-001 |  | \$119 |
| 4MB                                                                                | 118690-001 |  | \$269 |
| DeskPro 386-33, 486-33 and SystemPro                                               |            |  |       |
| 2MB                                                                                | 115144-001 |  | \$129 |
| 8MB                                                                                | 116561-001 |  | \$419 |
| DeskPro 386-20e and 25e                                                            |            |  |       |
| 1MB Board                                                                          | 113644-001 |  | \$139 |
| 4MB Board                                                                          | 113645-001 |  | \$309 |
| DeskPro 386S                                                                       |            |  |       |
| 1MB Board                                                                          | 113633-001 |  | \$139 |
| 4MB Board                                                                          | 113634-001 |  | \$329 |

## AST MEMORY

|                                           |            |  |       |
|-------------------------------------------|------------|--|-------|
| Premium 386C, 386-16                      |            |  |       |
| 4MB Kit                                   | 500510-008 |  | \$189 |
| Premium 386, 386-20                       |            |  |       |
| 4MB Kit                                   | 500510-004 |  | \$249 |
| Bravo 386-SX, WS/286, 386                 |            |  |       |
| 2MB Kit                                   | 500510-002 |  | \$99  |
| 4MB Kit                                   | 500510-008 |  | \$189 |
| 8MB Kit                                   | 500824-001 |  | \$389 |
| Premium 386/25-33, Premium II 386SX/16-20 |            |  |       |
| 1MB w/WPB                                 | 500780-003 |  | \$69  |
| All Premium and Bravo All Models          |            |  |       |
| 2MB w/WPB                                 | 500718-004 |  | \$129 |
| 8MB w/WPB                                 | 500780-001 |  | \$459 |
| Premium II 386SX/20 and 386SX/16          |            |  |       |
| 4MB w/WPB                                 | 500780-004 |  | \$229 |

## LAPTOP MEMORY



|                            |         |       |  |
|----------------------------|---------|-------|--|
| APPLE                      |         |       |  |
| Powerbook 100, 140, 170    | 2MB     | Call  |  |
|                            | 4MB     | Call  |  |
|                            | 6MB     | Call  |  |
| AST                        |         |       |  |
| Exec Notebook all models   | 1MB     | \$79  |  |
|                            | 4MB     | \$219 |  |
| COMPAQ                     |         |       |  |
| Portastar LIFE/286-20      | 1MB     | \$179 |  |
|                            | 4MB     | \$379 |  |
| Portable LTE 286           | 1MB     | \$89  |  |
|                            | 4MB     | \$219 |  |
| ELT-286                    | 1MB     | \$129 |  |
|                            | 4MB     | \$449 |  |
| ELT-386                    | 1MB     | \$129 |  |
|                            | 4MB     | \$399 |  |
| IBM                        |         |       |  |
| 140SX, N33SX laptop        | 2MB     | \$129 |  |
|                            | 4MB     | \$219 |  |
|                            | 6MB     | \$449 |  |
| TOSHIBA                    |         |       |  |
| T1000SE/LE/KE, T2000SX &   | 2MB     | \$229 |  |
| T1000LL, T2000SX, T2000SX  | 4MB     | \$359 |  |
|                            | 5MB     | \$789 |  |
| T1200XE, T1600, T3100E     | 2MB     | \$129 |  |
| T3100SX, T3200SX, SXC      | 2MB     | \$129 |  |
|                            | 4MB     | \$229 |  |
| T3200                      | 3MB     | \$229 |  |
| TS100                      | 2MB     | \$129 |  |
| TS200, TS200C, TS500       | 2MB     | \$129 |  |
|                            | 8MB     | \$469 |  |
| NEC                        |         |       |  |
| Powernote Port SX          | 2MB     | \$399 |  |
| ProSpeed 286, 386SX16      | 1MB     | \$129 |  |
|                            | 4MB     | \$399 |  |
| ProSpeed SX20              | 1MB     | \$159 |  |
|                            | 4MB     | \$449 |  |
| ZENITH                     |         |       |  |
| MastersPort SL             | 2MB     | \$209 |  |
| MastersPort 386SX          | 2MB     | \$209 |  |
| S S SX, 286E, SlimsPort    | 2MB     | \$169 |  |
| SupersPort SX              | 2MB     | \$169 |  |
| SupersPort 286, 286E       | 1MB kit | \$119 |  |
| SupersPort 286E, SlimsPort | 4MB     | \$449 |  |
| TurboPort 386, 386E        | 1MB     | \$169 |  |
| SANYO, EVEREX and ZEOS     |         |       |  |
| Notebook Memory            | 2MB     | \$199 |  |

## ZENITH MEMORY

|                               |             |  |        |
|-------------------------------|-------------|--|--------|
| Zenith 486/33ET               |             |  |        |
| 4MB Kit                       | ZA-4200-M2  |  | \$293  |
| 16MB Kit                      | ZA-4200-M8  |  | \$1279 |
| Zenith Z-386/20/25/33 and 33E |             |  |        |
| 1MB                           | ZA36/3800ME |  | \$69   |
| 4MB                           | ZA3800MK    |  | \$299  |

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| ST-4766NV NOV  | 676MB  | 15.5MS | \$1,419 |
| ST-41200N SCSI | 1050MB | 16.5MS | \$1,849 |
| ST-41200NV NOV | 1050MB | 16.5   | \$1,849 |
| ST-41650N SCSI | 1420MB | 17.5MS | \$2,319 |

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| ST-2383A IDE  | 338MB | 16MS | \$1,119 |
| ST-2383N SCSI | 337MB | 16MS | \$1,119 |
| ST-2383E ESDI | 337MB | 16MS | \$1,119 |

### CONTROLLERS

|                                         |      |
|-----------------------------------------|------|
| ST-01 SCSI 8 Bit Adaptor                | \$29 |
| ST-02 SCSI 8 Bit Adaptor w/FD Control   | \$45 |
| ST-07 IDE Controller Hard Drive Only    | \$29 |
| ST-08 IDE Controller - HD & Floppy      | \$39 |
| ST-11M MFM 8 Bit Controller             | \$51 |
| ST-11R RLL 8 Bit Controller             | \$51 |
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| 80387-DX                      | Call |

## MODEMS & COMMUNICATIONS

|                   |     |
|-------------------|-----|
| ATI 9600 ETC      | 399 |
| CPI 2400 Internal | 69  |
| CPI 2400 Ext Fax  | 123 |

|                            |         |
|----------------------------|---------|
| CPI 2400 Ext MNP           | 154     |
| CPI 9600 Ext               | 439     |
| Everex 2400/2400 MNP       | 99/164  |
| Hayes 2400/2400B           | 289/218 |
| Hayes Ultra 96             | 609     |
| Hayes Ultra 144            | 760     |
| Practical Pocket Modem     | 99      |
| Intel 2400/9600            | 217/454 |
| MegaHertz Laptop Modems    | Call    |
| Practical Perif. 2400/9600 | 132/479 |
| US Robotics Cour HST       | 550/585 |
| US Robotics Dual Std       | 760/779 |

## FAX MACHINES

|                        |             |
|------------------------|-------------|
| Sharp FO 216/240/334   | 559/699/795 |
| Intel Satisfaction/MCA | 369/421     |
| JT Fax 9600 B          | 339         |
| CPI 2496 IF            | 173         |
| US Robotics World Port | 315         |

## MICE

|                            |         |
|----------------------------|---------|
| Logitech C9/BUS/PS2        | 82      |
| Logitech Mouseman          | 72      |
| Logitech Scanman/PC/PS2    | 169/240 |
| Microsoft Mice/Windows 3.0 | 103/145 |
| Microsoft Ballpoint        | 129     |

## DRIVES & TAPES

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|----------------------------------|-------------|
| Colorado DJ10/20                 | 239/295     |
| Conner 40/105/210                | 199/345/550 |
| ST 225                           | 189         |
| ST 157A/251-1                    | 229/239     |
| Plus II XL50/105                 | 299/450     |
| Mountain All Models              | Call        |
| Panasonic LF 7010 1 Gb           |             |
| Erasable Optical Drive           | 2840        |
| Procom Ext 5.25 PS/2             | 199         |
| Procom PS2 Hard Drive 120/200 Mb | Call        |
| Procom Laptop Floppy             | Call        |

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|                              |           |
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| ARTISOFT                     |           |
| Lantastic 2 Mb Starter Kit   | 338       |
| Lantastic 2 Mb Adapter       | 139       |
| Lantastic 10 Mb Starter Kit  | 469       |
| Lantastic AE3 Starter Kit    | 539       |
| Lantastic 10 Mb Adapter      | 199       |
| NETWARE (Upgrades Available) |           |
| Netware 2.2 5-User           | 489       |
| Netware 2.2 10-User          | 1149      |
| Netware 3.11 10/20-User      | 1395/1995 |
| Netware 3.11 100-User        | 3900      |
| NE 1000/NE 2000              | 159/179   |
| NE/2 (NE 3200 (EISA))        | 249/749   |
| SMC                          |           |
| Arctnet PC 130 8 Bit         | 99        |
| Arctnet PC 500 fs 16 Bit     | 289       |
| Arctnet PC 500 ws 16 Bit     | 179       |

## MISC. & ACCESSORIES

|                             |              |
|-----------------------------|--------------|
| Keytronics KB101+           | 90           |
| Kensington Masterpiece/Plus | 85/95        |
| AB Switch Box               | 27           |
| Tripp Lite 500/1200/2000    |              |
| Tripp Lite Isotel           | 296/618/1175 |
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Accpac Plus Windowing Mgr  
Businessworks Bundle  
DAC Easy Accounting Payroll 4.2  
DAC Easy Bonus Pak 4.2  
DAC Easy Network  
Great American Works  
MicroBiz Retail Store Controller  
Pacioli 2000  
Realtree Complete III Accounting  
Realtree w/Data Query III  
Profitwise Power Pak  
Profitwise Accog (10-Pak)  
Timetrap III

116  
225  
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159  
369  
85/57  
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#### C.A.D.

Autocad 10  
Autocad v. 11  
Autosketch 3.0  
DesignCAD 3D  
Design CAD 5.0  
Drafix CAD Ultra  
Generic 3D Drafting  
Generic CAD 5.0  
Generic CAD Starter Kit  
Mathcad 2.5  
Mathcad Advanced Math Pak  
Turbo CAD

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2899  
137  
185  
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#### COMMUNICATIONS

Brooklyn Bridge 3.0  
Carbon Copy Plus  
Close Up Customer  
Close Up Support  
CoSession 2 user  
Crossstalk Communicator  
Crossstalk Mark IV  
Lap Link Pro  
Mirror III  
PC Anywhere III  
PC Anywhere IV  
PC Anywhere IV LAN  
Procom Plus  
Smarterm 240  
Smarterm 320  
Smarterm 400

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#### DATABASE

Advanced Revelation  
Alpha IV  
AskSam  
Clipper 5.01  
Database  
Data Flex 3.0  
Data Flex (Multiuser) 3.0  
DataPerfect  
dBase III Plus  
dBase III  
dBase IV Developer & Kit 1.1  
dBase IV LAN  
dBaseX 1.3  
Foxbase Plus 2.1 LAN  
Foxbase Plus 2.1 SAU runtime  
Foxbase 2.1 Single User  
Foxbase Plus LAN Runtime  
Fox Pro 2.0  
Fox Pro LAN 2.0  
Fox Pro Distribution Kit  
Informix 4GL Compiled  
Informix 4GL Compiled Runtime  
Informix SQL  
Informix SQL Runtime  
Oracle Professional  
Paradox 3.5  
PC File 6.0  
PC File LAN  
PFS Professional File  
Q & A 4.0  
Quicksilver Diamond  
R&R Code Generator  
R&R Reportwriter (dBase)  
RBase for DOS 3.1  
Reflex 2.0  
UI Programmer 2.1

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#### DESKTOP PUBLISHING

Adobe Illustrator Windows  
Express Publisher  
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Newsmaster II  
Newsroom Pro  
PageMaker 4.0  
Publish-It 2.0  
Publishers Paintbrush  
Publishers Power Plus/WW or Word  
Publisher's Type Foundry  
Ventura Gold For DOS

369  
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#### FINANCE

Managing Your Money  
Market Analyzer Plus  
Money Counts  
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Quicken 5.0

115  
279  
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39  
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#### GRAPHICS

Lotus 1-2-3 3.1 Server  
LUCID 3D  
Microsoft Excel  
Microsoft Multiplan  
Quattro Pro 3.0  
Quattro Pro LAN Pak  
Suvercalc V

229  
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#### INTEGRATED

386 Max 6.0  
Abacus Disc Plus  
Act I  
Allways 1.2  
Ami Diag  
Automen  
Battery Watch Pro  
Catchword  
Check It  
Control Room  
Copy II PC  
Copy II PC Deluxe Option Board  
Corporate Ladder  
Cruise Control  
Desquiew  
Desquiew 386  
Direct Access 5.0  
Direct Access Network  
Disk Manager  
Disk Optimizer  
Disk Technician Gold  
Diskette Manager III  
D R DOS 6.0  
FAST I  
Fastback Plus  
Fastlynx  
Fastpak Mail  
Fastpak  
Flight Simulator 4.0  
Geoworks Ensemble  
Go-Script 3.0  
Go-Script Plus 3.0  
Goler  
HDC Windows Express  
Hi Jaak  
Hyperpad  
Impress  
InfoSelect  
Instant Recall  
Ko Pilot for WP  
Label Pro  
Labels Unlimited  
Le Menu Plus  
Lotus Agenda  
Lotus Magellan 2.0  
Mace 1990  
Mace Vaccine  
Mavis Beacon Teaches Typing  
Memory Mate  
Menuworks  
Microsoft DOS 3.3 w/GWBasic  
Microsoft DOS 4.01 w/GWBasic  
Microsoft DOS 5.0 Upgrade  
Microsoft DOS 5.0 w/Basic  
Microsoft Learning DOS  
Microsoft Windows 3.0  
Netroom  
Netroom (10 user)  
Norton Utilities 5.01  
Norton Anti Virus  
Norton Backup  
Norton Commander 3.0  
Norton Editor  
Optune  
OS/2 Extended  
OS/2 Standard  
Pathfinder 4.11  
Pathfinder Plus  
PC Tools 7.1  
PC MOS 386  
PC MOS 386 (5 user)  
Pop-Drop Plus  
Print Q 3.0  
Prokey Plus  
QA Plus  
QDOS III  
OEMM  
ORAM  
Readright For Windows  
Sidekick 2.0  
Sidekicks 3.3  
Software Bridge  
Software Carousel  
Speedstor  
Speedstor w/Card  
Sprite II  
Suzi  
Stacker  
Stacker w/Board CATS  
Stacker w/Board XT  
Super PC-Wik  
Super PC-Wik/Power Pak  
Switch-It  
Turbo EMS

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#### MICE & SCANNERS

IMSt Mouse  
Kensington Expert Mouse PC  
Kraft Trackball  
Logitech Mouse Man Bus  
Logitech Mouse Man Serial  
Logitech Mouse w/Paintshow  
Logitech Mouse (Serial) Windows 3.0  
Logitech Scanman 256  
Logitech Scanman 32  
Logitech Trackman  
Microsoft Mouse  
Microsoft Mouse w/Paintbrush  
Microsoft Mouse w/Windows 3.0  
MS Mouse (5-Pak)  
PC Mouse III  
PC Trackball (serial)

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#### NETWORKING

DeskLink 2.2  
Lantronic Ethernet Starter  
Lantronic Network Eye  
Lantronic Starter Kit  
Novell Netware 2.2 5 user  
Novell Netware 2.2 10 user  
Novell Netware 2.2 50 user  
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Novell Netware 3.11 100 user  
Novell Netware Lite

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129  
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1249  
2399  
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#### PAINTING

Arts & Letters Graphics Editor  
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Draw Perfect  
Flowcharting III  
Formfiller  
Formtool Gold  
Formworks w/fill n file  
GEM/3 Draw Plus  
Grasp  
Gray Fix  
IBM Storyboard Live  
Lotus Freelance Graphics  
Org Plus Advanced  
PC Globe  
PC Paintbrush IV Plus  
PC USA  
Per Form  
Puzzle Plus  
Printmaster Plus  
Printshop  
Softtype

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#### PROGRAMMING

APL Plus/PC  
Borland C++  
Brief Editor  
Brief dBrief  
Clarion Personal Developer 2.0  
Clarion Professional Developer 2.1  
v-Edit  
Microsoft Basic PDS 7.1  
Microsoft C Compiler 6.0  
Microsoft Cobol Compiler  
Microsoft Fortran 5.0  
Microsoft Macro Assembler 6.0  
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#### PROJECT MANAGEMENT

Harvard Project Manager 3.0  
Project Scheduler V  
Superproject 2.0  
Timeline 5.0  
Timeline 5.0 LAN Pak

419  
427  
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429  
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#### SPREADSHEETS

Lotus 1-2-3 2.3  
Lotus 1-2-3 3.1 Server  
Lotus 1-2-3 3.1 Plus

322  
569  
395

#### UTILITIES

386 Max 6.0  
Abacus Disc Plus  
Act I  
Allways 1.2  
Ami Diag  
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Battery Watch Pro  
Catchword  
Check It  
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Flight Simulator 4.0  
Geoworks Ensemble  
Go-Script 3.0  
Go-Script Plus 3.0  
Goler  
HDC Windows Express  
Hi Jaak  
Hyperpad  
Impress  
InfoSelect  
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Ko Pilot for WP  
Label Pro  
Labels Unlimited  
Le Menu Plus  
Lotus Agenda  
Lotus Magellan 2.0  
Mace 1990  
Mace Vaccine  
Mavis Beacon Teaches Typing  
Memory Mate  
Menuworks  
Microsoft DOS 3.3 w/GWBasic  
Microsoft DOS 4.01 w/GWBasic  
Microsoft DOS 5.0 Upgrade  
Microsoft DOS 5.0 w/Basic  
Microsoft Learning DOS  
Microsoft Windows 3.0  
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Netroom (10 user)  
Norton Utilities 5.01  
Norton Anti Virus  
Norton Backup  
Norton Commander 3.0  
Norton Editor  
Optune  
OS/2 Extended  
OS/2 Standard  
Pathfinder 4.11  
Pathfinder Plus  
PC Tools 7.1  
PC MOS 386  
PC MOS 386 (5 user)  
Pop-Drop Plus  
Print Q 3.0  
Prokey Plus  
QA Plus  
QDOS III  
OEMM  
ORAM  
Readright For Windows  
Sidekick 2.0  
Sidekicks 3.3  
Software Bridge  
Software Carousel  
Speedstor  
Speedstor w/Card  
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Suzi  
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Stacker w/Board CATS  
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Letterperfect  
Microsoft Word 5.5  
Microsoft Word For Windows  
Multimate 4.0  
Personal Law Firm  
PFS Professional Write  
Rightwriter 4.0  
Wordperfect 5.1  
Wordperfect Office PC  
Wordperfect Office PC (1.5u)  
Wordperfect Office PC (1-20u)  
Wordstar 6.0  
Xyrite III  
Xyrite 3.1  
Zyindex Professional 3.0

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#### XENIX / UNIX

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Informix 4GL Xenix 386 Runtime  
MS Word 5.0 for Xenix/Unix  
Norton Utilities For Unix  
RM Cobol 85 for Unix 386  
SCO Foxbase + 386 Run Xenix  
SCO Foxbase + 386 Xenix  
SCO Lynx 386 Xenix  
SCO Manager 386 Xenix  
SCO Professional 386 Xenix  
SCO Unix 386 Development System  
SCO Unix 386 Operating System  
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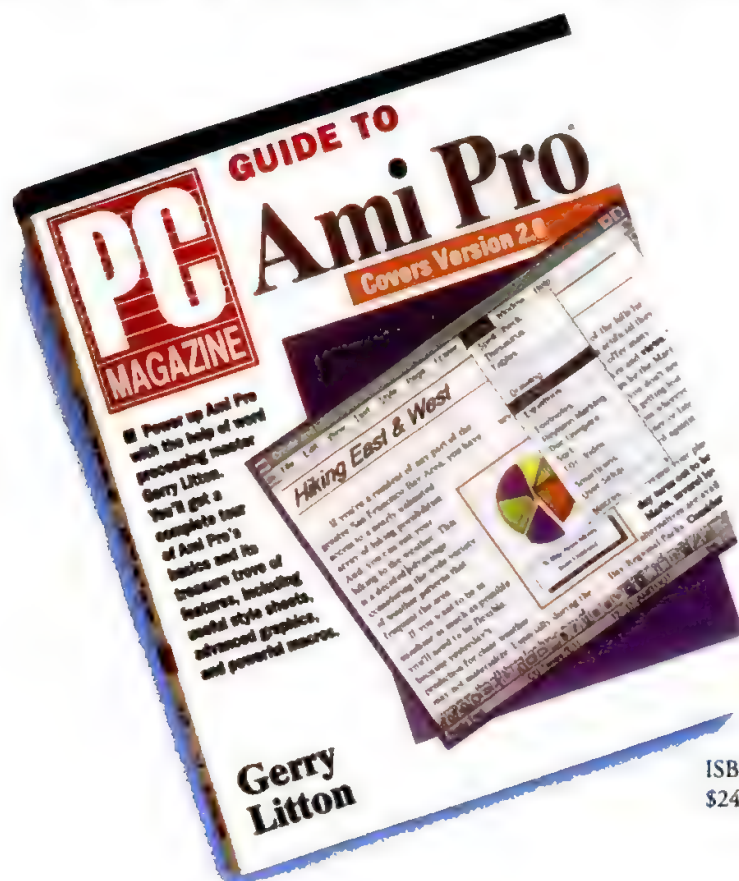
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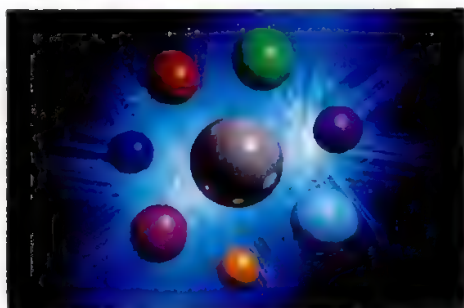
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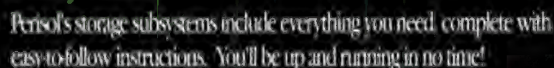
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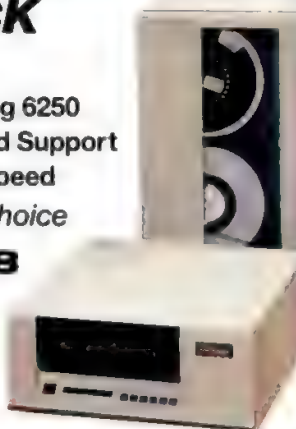
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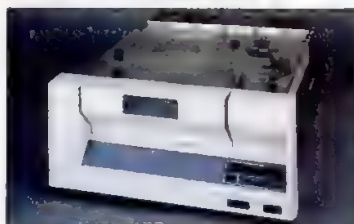
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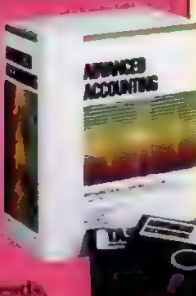
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| Written using 4th generation language                                                         | NO                       | NO                      | YES                                       |
| Source code included/modifiable                                                               | NO                       | NO                      | YES                                       |
| Easy-to-change file structures                                                                | NO                       | NO                      | YES                                       |
| Report generator included                                                                     | YES                      | NO                      | YES                                       |
| Multiuser LAN option included                                                                 | NO                       | NO                      | YES                                       |
| Real time postings                                                                            | NO                       | NO                      | YES                                       |
| 3-years GL data by month active                                                               | NO                       | NO                      | YES                                       |
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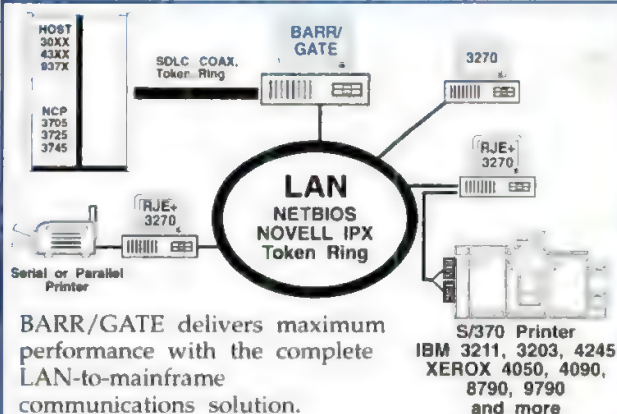
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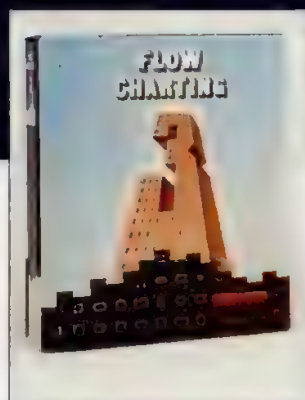
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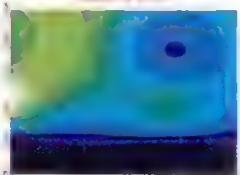
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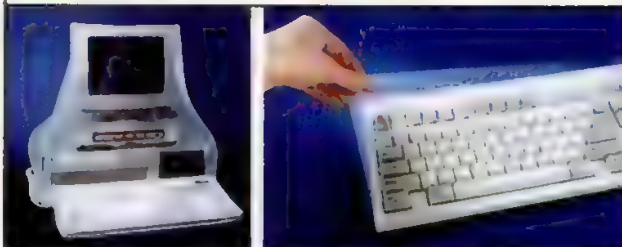
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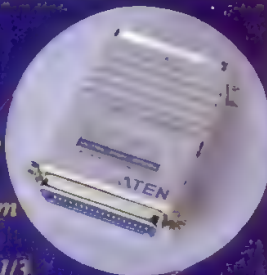
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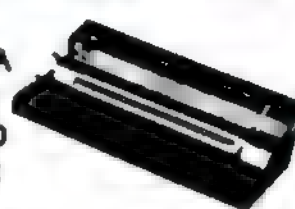
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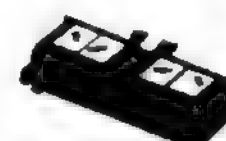
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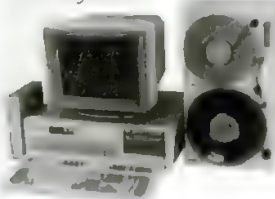
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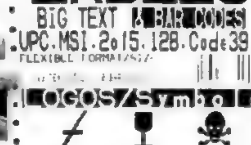
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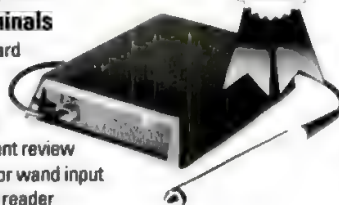
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| 741  | 742  | 743  | 744  | 745  | 746  | 747  | 748  | 749  | 750  | 751  | 752  | 753  | 754  | 755  | 756  | 757  | 758  | 759  | 760  | 761  | 762  | 763  | 764  | 765  | 766  | 767  | 768  | 769  | 770  | 771  | 772  | 773  | 774  | 775  | 776  | 777  | 778  | 779  | 780  | 781  | 782  | 783  | 784  | 785  | 786  | 787  |
| 788  | 789  | 790  | 791  | 792  | 793  | 794  | 795  | 796  | 797  | 798  | 799  | 800  | 801  | 802  | 803  | 804  | 805  | 806  | 807  | 808  | 809  | 810  | 811  | 812  | 813  | 814  | 815  | 816  | 817  | 818  | 819  | 820  | 821  | 822  | 823  | 824  | 825  | 826  | 827  | 828  | 829  | 830  | 831  | 832  | 833  | 834  |
| 835  | 836  | 837  | 838  | 839  | 840  | 841  | 842  | 843  | 844  | 845  | 846  | 847  | 848  | 849  | 850  | 851  | 852  | 853  | 854  | 855  | 856  | 857  | 858  | 859  | 860  | 861  | 862  | 863  | 864  | 865  | 866  | 867  | 868  | 869  | 870  | 871  | 872  | 873  | 874  | 875  | 876  | 877  | 878  | 879  | 880  | 881  |
| 882  | 883  | 884  | 885  | 886  | 887  | 888  | 889  | 890  | 891  | 892  | 893  | 894  | 895  | 896  | 897  | 898  | 899  | 900  | 901  | 902  | 903  | 904  | 905  | 906  | 907  | 908  | 909  | 910  | 911  | 912  | 913  | 914  | 915  | 916  | 917  | 918  | 919  | 920  | 921  | 922  | 923  | 924  | 925  | 926  | 927  | 928  |
| 929  | 930  | 931  | 932  | 933  | 934  | 935  | 936  | 937  | 938  | 939  | 940  | 941  | 942  | 943  | 944  | 945  | 946  | 947  | 948  | 949  | 950  | 951  | 952  | 953  | 954  | 955  | 956  | 957  | 958  | 959  | 960  | 961  | 962  | 963  | 964  | 965  | 966  | 967  | 968  | 969  | 970  | 971  | 972  | 973  | 974  | 975  |
| 976  | 977  | 978  | 979  | 980  | 981  | 982  | 983  | 984  | 985  | 986  | 987  | 988  | 989  | 990  | 991  | 992  | 993  | 994  | 995  | 996  | 997  | 998  | 999  | 1000 | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 | 1008 | 1009 | 1010 | 1011 | 1012 | 1013 | 1014 | 1015 | 1016 | 1017 | 1018 | 1019 | 1020 | 1021 | 1022 |
| 1023 | 1024 | 1025 | 1026 | 1027 | 1028 | 1029 | 1030 | 1031 | 1032 | 1033 | 1034 | 1035 | 1036 | 1037 | 1038 | 1039 | 1040 | 1041 | 1042 | 1043 | 1044 | 1045 | 1046 | 1047 | 1048 | 1049 | 1050 | 1051 | 1052 | 1053 | 1054 | 1055 | 1056 | 1057 | 1058 | 1059 | 1060 | 1061 | 1062 | 1063 | 1064 | 1065 | 1066 | 1067 | 1068 | 1069 |
| 1070 | 1071 | 1072 | 1073 | 1074 | 1075 | 1076 | 1077 | 1078 | 1079 | 1080 | 1081 | 1082 | 1083 | 1084 | 1085 | 1086 | 1087 | 1088 | 1089 | 1090 | 1091 | 1092 | 1093 | 1094 | 1095 | 1096 | 1097 | 1098 | 1099 | 1100 | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1107 | 1108 | 1109 | 1110 | 1111 | 1112 | 1113 | 1114 | 1115 | 1116 |
| 1117 | 1118 | 1119 | 1120 | 1121 | 1122 | 1123 | 1124 | 1125 | 1126 | 1127 | 1128 | 1129 | 1130 | 1131 | 1132 | 1133 | 1134 | 1135 | 1136 | 1137 | 1138 | 1139 | 1140 | 1141 | 1142 | 1143 | 1144 | 1145 | 1146 | 1147 | 1148 | 1149 | 1150 | 1151 | 1152 | 1153 | 1154 | 1155 | 1156 | 1157 | 1158 | 1159 | 1160 | 1161 | 1162 | 1163 |
| 1164 | 1165 | 1166 | 1167 | 1168 | 1169 | 1170 | 1171 | 1172 | 1173 | 1174 | 1175 | 1176 | 1177 | 1178 | 1179 | 1180 | 1181 | 1182 | 1183 | 1184 | 1185 | 1186 | 1187 | 1188 | 1189 | 1190 | 1191 | 1192 | 1193 | 1194 | 1195 | 1196 | 1197 | 1198 | 1199 | 1200 |      |      |      |      |      |      |      |      |      |      |

PC 3/31-6

1. Do you work in a DP/MIS department?  
01. ☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity. (Check one only.)

- 01. ☐ Manufacturer of Computer Equipment, Computers, Software
- 02. ☐ Manufacturer—Aerospace
- 03. ☐ Manufacturer—Other
- 04. ☐ Systems House
- 05. ☐ Computer Consultant
- 06. ☐ Computer Retailer/VAR/VAD Distributor
- 07. ☐ Communications
- 08. ☐ Finance/Banking/Insurance/Real Estate/Accounting
- 09. ☐ Education
- 10. ☐ Government—Federal
- 11. ☐ Government—Non-Federal
- 12. ☐ Research and Development
- 13. ☐ Data Processing/Computer Service
- 14. ☐ Health/Medical/Legal Service
- 15. ☐ Engineering/Architecture

16. ☐ Agriculture/Construction/Mining/Oil/Transportation/Utilities

17. ☐ Non-Computer Retailer/Distributor

18. ☐ Other Business or Service  
99. ☐ Other

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- 03. ☐ Communications
- 04. ☐ Engineering
- 05. ☐ Res./Dev./Scientific
- 06. ☐ Accounting/Finance
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- 08. ☐ Purchasing
- 09. ☐ Operations
- 10. ☐ Production
- 11. ☐ Education/Training
- 12. ☐ Marketing/Sales
- 13. ☐ Medical/Legal
- 14. ☐ Admin./Mgmt.
- 99. ☐ Other

4. Is your company a reseller?  
01. ☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products?

- 01. ☐ 10 or less 03. ☐ 26-99
- 02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office? (Check all that apply.)

- 01. ☐ Linked to mainframe
- 02. ☐ Linked to mini
- 03. ☐ Networked together

7. Please check the equipment currently installed at your location. (Check all that apply.)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Minis
- 04. ☐ Macintosh

8. Do you plan to buy any PC Products?  
01. ☐ Now

- 02. ☐ In 4 to 6 months
- 03. ☐ In 7 to 12 months
- 04. ☐ No definite plans

9. Number of Employees in your entire company:

- 01. ☐ 25 or less
- 02. ☐ 26-99
- 03. ☐ 100-499
- 04. ☐ 500-999
- 05. ☐ 1000 or more

Please print.

Name \_\_\_\_\_

Title \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

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|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 036  | 037  | 038  | 039  | 040  | 041  | 042  | 043  | 044  | 045  | 046  | 047  | 048  | 049  | 050  | 051  | 052  | 053  | 054  | 055  | 056  | 057  | 058  | 059  | 060  | 061  | 062  | 063  | 064  | 065  | 066  | 067  | 068  | 069  | 070  | 071  | 072  | 073  | 074  | 075  | 076  | 077  | 078  | 079  | 080  | 081  | 082  |      |      |      |
| 083  | 084  | 085  | 086  | 087  | 088  | 089  | 090  | 091  | 092  | 093  | 094  | 095  | 096  | 097  | 098  | 099  | 100  | 101  | 102  | 103  | 104  | 105  | 106  | 107  | 108  | 109  | 110  | 111  | 112  | 113  | 114  | 115  | 116  | 117  | 118  | 119  | 120  | 121  | 122  | 123  | 124  | 125  | 126  | 127  | 128  | 129  |      |      |      |
| 130  | 131  | 132  | 133  | 134  | 135  | 136  | 137  | 138  | 139  | 140  | 141  | 142  | 143  | 144  | 145  | 146  | 147  | 148  | 149  | 150  | 151  | 152  | 153  | 154  | 155  | 156  | 157  | 158  | 159  | 160  | 161  | 162  | 163  | 164  | 165  | 166  | 167  | 168  | 169  | 170  | 171  | 172  | 173  | 174  | 175  | 176  |      |      |      |
| 177  | 178  | 179  | 180  | 181  | 182  | 183  | 184  | 185  | 186  | 187  | 188  | 189  | 190  | 191  | 192  | 193  | 194  | 195  | 196  | 197  | 198  | 199  | 200  | 201  | 202  | 203  | 204  | 205  | 206  | 207  | 208  | 209  | 210  | 211  | 212  | 213  | 214  | 215  | 216  | 217  | 218  | 219  | 220  | 221  | 222  | 223  |      |      |      |
| 224  | 225  | 226  | 227  | 228  | 229  | 230  | 231  | 232  | 233  | 234  | 235  | 236  | 237  | 238  | 239  | 240  | 241  | 242  | 243  | 244  | 245  | 246  | 247  | 248  | 249  | 250  | 251  | 252  | 253  | 254  | 255  | 256  | 257  | 258  | 259  | 260  | 261  | 262  | 263  | 264  | 265  | 266  | 267  | 268  | 269  | 270  |      |      |      |
| 271  | 272  | 273  | 274  | 275  | 276  | 277  | 278  | 279  | 280  | 281  | 282  | 283  | 284  | 285  | 286  | 287  | 288  | 289  | 290  | 291  | 292  | 293  | 294  | 295  | 296  | 297  | 298  | 299  | 300  | 301  | 302  | 303  | 304  | 305  | 306  | 307  | 308  | 309  | 310  | 311  | 312  | 313  | 314  | 315  | 316  | 317  |      |      |      |
| 318  | 319  | 320  | 321  | 322  | 323  | 324  | 325  | 326  | 327  | 328  | 329  | 330  | 331  | 332  | 333  | 334  | 335  | 336  | 337  | 338  | 339  | 340  | 341  | 342  | 343  | 344  | 345  | 346  | 347  | 348  | 349  | 350  | 351  | 352  | 353  | 354  | 355  | 356  | 357  | 358  | 359  | 360  | 361  | 362  | 363  | 364  |      |      |      |
| 365  | 366  | 367  | 368  | 369  | 370  | 371  | 372  | 373  | 374  | 375  | 376  | 377  | 378  | 379  | 380  | 381  | 382  | 383  | 384  | 385  | 386  | 387  | 388  | 389  | 390  | 391  | 392  | 393  | 394  | 395  | 396  | 397  | 398  | 399  | 400  | 401  | 402  | 403  | 404  | 405  | 406  | 407  | 408  | 409  | 410  | 411  |      |      |      |
| 412  | 413  | 414  | 415  | 416  | 417  | 418  | 419  | 420  | 421  | 422  | 423  | 424  | 425  | 426  | 427  | 428  | 429  | 430  | 431  | 432  | 433  | 434  | 435  | 436  | 437  | 438  | 439  | 440  | 441  | 442  | 443  | 444  | 445  | 446  | 447  | 448  | 449  | 450  | 451  | 452  | 453  | 454  | 455  | 456  | 457  | 458  |      |      |      |
| 459  | 460  | 461  | 462  | 463  | 464  | 465  | 466  | 467  | 468  | 469  | 470  | 471  | 472  | 473  | 474  | 475  | 476  | 477  | 478  | 479  | 480  | 481  | 482  | 483  | 484  | 485  | 486  | 487  | 488  | 489  | 490  | 491  | 492  | 493  | 494  | 495  | 496  | 497  | 498  | 499  | 500  | 501  | 502  | 503  | 504  | 505  |      |      |      |
| 506  | 507  | 508  | 509  | 510  | 511  | 512  | 513  | 514  | 515  | 516  | 517  | 518  | 519  | 520  | 521  | 522  | 523  | 524  | 525  | 526  | 527  | 528  | 529  | 530  | 531  | 532  | 533  | 534  | 535  | 536  | 537  | 538  | 539  | 540  | 541  | 542  | 543  | 544  | 545  | 546  | 547  | 548  | 549  | 550  | 551  | 552  |      |      |      |
| 553  | 554  | 555  | 556  | 557  | 558  | 559  | 560  | 561  | 562  | 563  | 564  | 565  | 566  | 567  | 568  | 569  | 570  | 571  | 572  | 573  | 574  | 575  | 576  | 577  | 578  | 579  | 580  | 581  | 582  | 583  | 584  | 585  | 586  | 587  | 588  | 589  | 590  | 591  | 592  | 593  | 594  | 595  | 596  | 597  | 598  | 599  |      |      |      |
| 600  | 601  | 602  | 603  | 604  | 605  | 606  | 607  | 608  | 609  | 610  | 611  | 612  | 613  | 614  | 615  | 616  | 617  | 618  | 619  | 620  | 621  | 622  | 623  | 624  | 625  | 626  | 627  | 628  | 629  | 630  | 631  | 632  | 633  | 634  | 635  | 636  | 637  | 638  | 639  | 640  | 641  | 642  | 643  | 644  | 645  | 646  |      |      |      |
| 647  | 648  | 649  | 650  | 651  | 652  | 653  | 654  | 655  | 656  | 657  | 658  | 659  | 660  | 661  | 662  | 663  | 664  | 665  | 666  | 667  | 668  | 669  | 670  | 671  | 672  | 673  | 674  | 675  | 676  | 677  | 678  | 679  | 680  | 681  | 682  | 683  | 684  | 685  | 686  | 687  | 688  | 689  | 690  | 691  | 692  | 693  |      |      |      |
| 694  | 695  | 696  | 697  | 698  | 699  | 700  | 701  | 702  | 703  | 704  | 705  | 706  | 707  | 708  | 709  | 710  | 711  | 712  | 713  | 714  | 715  | 716  | 717  | 718  | 719  | 720  | 721  | 722  | 723  | 724  | 725  | 726  | 727  | 728  | 729  | 730  | 731  | 732  | 733  | 734  | 735  | 736  | 737  | 738  | 739  | 740  |      |      |      |
| 741  | 742  | 743  | 744  | 745  | 746  | 747  | 748  | 749  | 750  | 751  | 752  | 753  | 754  | 755  | 756  | 757  | 758  | 759  | 760  | 761  | 762  | 763  | 764  | 765  | 766  | 767  | 768  | 769  | 770  | 771  | 772  | 773  | 774  | 775  | 776  | 777  | 778  | 779  | 780  | 781  | 782  | 783  | 784  | 785  | 786  | 787  |      |      |      |
| 788  | 789  | 790  | 791  | 792  | 793  | 794  | 795  | 796  | 797  | 798  | 799  | 800  | 801  | 802  | 803  | 804  | 805  | 806  | 807  | 808  | 809  | 810  | 811  | 812  | 813  | 814  | 815  | 816  | 817  | 818  | 819  | 820  | 821  | 822  | 823  | 824  | 825  | 826  | 827  | 828  | 829  | 830  | 831  | 832  | 833  | 834  |      |      |      |
| 835  | 836  | 837  | 838  | 839  | 840  | 841  | 842  | 843  | 844  | 845  | 846  | 847  | 848  | 849  | 850  | 851  | 852  | 853  | 854  | 855  | 856  | 857  | 858  | 859  | 860  | 861  | 862  | 863  | 864  | 865  | 866  | 867  | 868  | 869  | 870  | 871  | 872  | 873  | 874  | 875  | 876  | 877  | 878  | 879  | 880  | 881  |      |      |      |
| 882  | 883  | 884  | 885  | 886  | 887  | 888  | 889  | 890  | 891  | 892  | 893  | 894  | 895  | 896  | 897  | 898  | 899  | 900  | 901  | 902  | 903  | 904  | 905  | 906  | 907  | 908  | 909  | 910  | 911  | 912  | 913  | 914  | 915  | 916  | 917  | 918  | 919  | 920  | 921  | 922  | 923  | 924  | 925  | 926  | 927  | 928  |      |      |      |
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| 976  | 977  | 978  | 979  | 980  | 981  | 982  | 983  | 984  | 985  | 986  | 987  | 988  | 989  | 990  | 991  | 992  | 993  | 994  | 995  | 996  | 997  | 998  | 999  | 1000 | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 | 1008 | 1009 | 1010 | 1011 | 1012 | 1013 | 1014 | 1015 | 1016 | 1017 | 1018 | 1019 | 1020 | 1021 | 1022 |      |      |      |
| 1023 | 1024 | 1025 | 1026 | 1027 | 1028 | 1029 | 1030 | 1031 | 1032 | 1033 | 1034 | 1035 | 1036 | 1037 | 1038 | 1039 | 1040 | 1041 | 1042 | 1043 | 1044 | 1045 | 1046 | 1047 | 1048 | 1049 | 1050 | 1051 | 1052 | 1053 | 1054 | 1055 | 1056 | 1057 | 1058 | 1059 | 1060 | 1061 | 1062 | 1063 | 1064 | 1065 | 1066 | 1067 | 1068 | 1069 | 1070 |      |      |
| 1071 | 1072 | 1073 | 1074 | 1075 | 1076 | 1077 | 1078 | 1079 | 1080 | 1081 | 1082 | 1083 | 1084 | 1085 | 1086 | 1087 | 1088 | 1089 | 1090 | 1091 | 1092 | 1093 | 1094 | 1095 | 1096 | 1097 | 1098 | 1099 | 1100 | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1107 | 1108 | 1109 | 1110 | 1111 | 1112 | 1113 | 1114 | 1115 | 1116 | 1117 | 1118 | 1119 | 1120 |
| 1121 | 1122 | 1123 | 1124 | 1125 | 1126 | 1127 | 1128 | 1129 | 1130 | 1131 | 1132 | 1133 | 1134 | 1135 | 1136 | 1137 | 1138 | 1139 | 1140 | 1141 | 1142 | 1143 | 1144 | 1145 | 1146 | 1147 | 1148 | 1149 | 1150 | 1151 | 1152 | 1153 | 1154 | 1155 | 1156 | 1157 | 1158 | 1159 | 1160 | 1161 | 1162 | 1163 | 1164 | 1165 | 1166 | 1167 | 1168 |      |      |
| 1169 | 1170 | 1171 | 1172 | 1173 | 1174 | 1175 | 1176 | 1177 | 1178 | 1179 | 1180 | 1181 | 1182 | 1183 | 1184 | 1185 | 1186 | 1187 | 1188 | 1189 | 1190 | 1191 | 1192 | 1193 | 1194 | 1195 | 1196 | 1197 | 1198 | 1199 | 1200 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

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- 10. ☐ Government—Federal
- 11. ☐ Government—Non-Federal
- 12. ☐ Research and Development
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17. ☐ Non-Computer Retailer/Distributor

18. ☐ Other Business or Service

99. ☐ Other

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7. Please check the equipment currently installed at your location: (Check all that apply.)

- 01. ☐ IBM or Compatible PCs
- 02. ☐ IBM or Compatible Mainframes
- 03. ☐ IBM or Compatible Minis
- 04. ☐ Macintosh

8. Do you plan to buy any PC Products?  
01. ☐ Now

- 02. ☐ In 4 to 6 months
- 03. ☐ In 7 to 12 months
- 04. ☐ No definite plans

9. Number of Employees in your entire company:

- 01. ☐ 25 or less
- 02. ☐ 26-99
- 03. ☐ 100-499
- 04. ☐ 500-999
- 05. ☐ 1000 or more

Please print.

Name \_\_\_\_\_

Title \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

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## DATA RECOVERY SERVICES

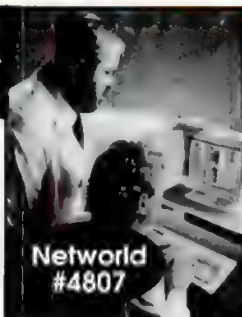
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- \$5,400 on software
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PC Magazine is published 22 times a year. (bimonthly except for July and August). The BusinessCard closing is approximately two months prior to issue date.  
Please send copy and payment to: PC Magazine BusinessCard, One Park Avenue, 3rd Floor, New York, NY 10016, ATT: Richard Wortman. For more information, call Richard Wortman at 800-825-4237 or 212-503-5175, FAX: 212-503-5860.

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| 309     | LANtek Computer, Inc.           | Mail Order.....                 | 403     |
| 010     | Midwest Computer Works          | Mail Order PCs.....             | 394     |
| 145     | Paradise Computer Products Ltd. | Systems, Mail Order.....        | 414     |
| 092     | PCs Complet                     | PCs.....                        | 395-397 |
| 343     | Performance Memory Products     | Mail Order, Memory.....         | 405     |
| 349     | S&W Electronics                 | Mail Order.....                 | 411     |
| 373     | Software Add-Ons                | Mail Order.....                 | 415     |
| 106     | Tenex Computer Express          | Mail Order Memory Products..... | 408     |
| 191     | USA Flex                        | Compatibles.....                | 400-401 |

For Additional Product Categories See  
MARKETPLACE PRODUCT INDEX Page 417

## ■ LOW-COST LANs

The connectivity team complements its March 31, 1992, LAN overview ("Connectivity Simplified: An Introduction to the Ways of Networking") with a review of a dozen low-cost, DOS-based LANs. In the past year, two industry giants—Novell and Hayes—have added their names to products in the field, and implementation of speed-enhancing features such as disk caching has become standard for serious networking contenders. Where does that leave Artisoft and Performance Technology, last year's Editors' Choice winners?

## ■ MINICARTRIDGE BACKUP SYSTEMS

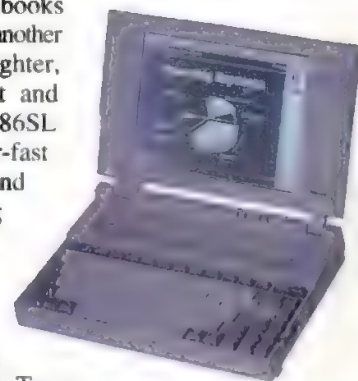
With prices going down, QIC-80 tape drives are becoming sound storage solutions for standalone and small network users alike. QIC-80 tape drives are not only faster than floppy disk drives, but they can also store 120MB with extended length tape—and up to 250MB with data compression. PC Magazine Labs puts 13 new tape drives to the test, with offerings from Alloy, Colorado Memory Systems, Everex, Irwin, and others.

## ■ DESKTOP COLOR SCANNERS

A hand scanner was a good idea for a while, but now we want the convenience and accuracy of a desktop flatbed scanner, with 24 bits of color. And we want one that doesn't cost more than \$4,000; as a matter of fact, it should cost less than \$2,000. PC Magazine has found nine color scanners in this price range, and after weighing considerations such as ease of use and bundled software packages, lets you know which are worth buying.

## ■ CUTTING-EDGE NOTEBOOKS

As standard 386SX notebooks flood the market, there's yet another cry for smaller, faster, lighter, and better systems. Fast and efficient 386SX and 386SL processors (even a super-fast 486SX), lighter cases, and advanced features are among the hallmarks of portable PCs from vendors such as AST, AT&T, Compaq, Epson, Everex, GRiD Systems, Librex, Magnavox, Philips, NEC, Texas Instruments, Toshiba, and Zenith Data Systems.



## ■ UTILITIES

Have you ever wanted to copy a block of text from one program to another? With Windows, the task is trivial; you can just use the Windows clipboard. Now we've added a clipboard to DOS, too: DOSCLIP.COM, next issue's utility. DOSCLIP.COM provides the cut-and-paste services of the Windows clipboard in the DOS environment. DOSCLIP even allows DOS applications to copy data to and from the Windows clipboard.



## After Hours

### The Treehouse

CONTINUED

mice." It will make your children want to explore more, whether in your local city park or your own backyard.

*The Treehouse* gives children room to grow and encourages them to explore and learn. Kids keep coming back to the program to discover more after they've learned new facts, created their own instruments, or explored outdoors. Packed with activities for young boys and



girls, *The Treehouse* might well earn your own family's "product of the year" award.

**List Price:** *The Treehouse*, \$59.95. Broderbund Software, 500 Redwood Blvd., Novato,

CA 94948-6121; 800-521-6263, 415-382-4400.

**Requires:** 640K RAM, 3MB hard disk space, EGA display or better, DOS 3.0 or later.

CIRCLE 471 ON READER SERVICE CARD

Children create their own stories (and hone their language skills) in *The Treehouse Theater* by using a variety of backgrounds, characters, and actions.

documentation offers tips on using the software as well as a Learning Guide to show parents how to use it with their children. Kids will delight in the graphics and interactive options that come with the program. Adults, however, will have to do a bit of explaining from time to time.

The beauty, as well as the detriment, of the program is that the sound, graphics, and text files that make *Knowledge Adventure* so rich come packed on six high-density 5.25-inch floppy disks. You'd expect to find this program on CD-ROM. Those who lack a ROM reader will appreciate the fact that they can use the program, albeit at the expense of 6MB of hard disk space.

*Knowledge Adventure* is a wonderful program that even makes installing the software a useful learning experience. As the program copies files to your hard disk, it displays graphics and text that describe how to use the program, what happens when you click on its icons, how to zoom through space and time, or how to get help from the program. You'll know how to use the program by the time you've finished installing it, all without a glance at its software manual.

*Knowledge Adventure* is not only a must in any electronic reference set, it is the first in a series of planned adventures. The company plans to produce the next program in the series, *Sports Adventures*, this winter.

**List Price:** *Knowledge Adventure*, \$79.95. Knowledge Adventure Inc., 4502 Dyer St., #100, LaCrescenta, CA 91214; 800-542-4240, 818-542-4200.

**Requires:** 320K RAM, 6MB hard disk space, EGA display or better, DOS 3.1 or later.

CIRCLE 472 ON READER SERVICE CARD

## Knowledge Adventure: An Educational Trip Through Space and Time

By Carol Hays

Maybe it's the *Thus Spake Zarathustra* musical opening, the zoomable cosmos, or the graphic of a floating embryo that pops up when you reference genetics. But children of the sixties will delight in the 2001: *A Space Odyssey* themes of the interactive almanac, *Knowledge Adventure*, as much as children of the nineties will revel in the adventure it makes of modern reference.

Never mind that the kids don't know the movie. This \$79.95 multimedia excursion through time and space is more entertaining than a trip to the library and only as far away as your keyboard.

*Knowledge Adventure* users navigate through history and space by moving a sliding time line bar beneath the program's main picture graphic and a slid-

ing distance bar beneath its Earth view. With them, you can travel from the year 10 billion B.C. to "beyond 2000 A.D.," from distances of 100 miles from the earth to 100,000 light years into the cosmos. Move the time slider to the year 1 to reveal a picture of the crucifixion of Christ. The text box gives an account of the event, along with a description of the meanings of B.C. and A.D. Move it to 10 billion B.C. and you see a picture of the big bang (although, oddly, the date that pops up with the picture is 15 billion B.C.). "Beyond 2000 A.D." shows a scene to make Buckminster Fuller proud, a fabulous graphic of geodesic domes and high-speed trains.

*Knowledge Adventure's* technical achievements are impressive as well. Developed by Bill Gross, creator of Lotus's *Magellan*, the program uses a system of hyperlinks to connect sound,

graphics, and text files. While its screen graphics are only 16 colors, *Knowledge Adventure* produces lustrous visuals by using dot patterns of 4 adjacent pixels to give the look of many more screen colors. This also means that it's viewable on EGA screens. And it calculates points on the vectorized maps so quickly that the program will accurately compute new map locations as kids click their way around the globe.

By clicking on icons, you link to other screens that describe the art, science, literature, architecture, music, or nature of the selected locale and era. The text is also lengthy, requiring kids to read through several screens to get the full meaning. Or you can get a printout, retrace your steps, and hear voices, music, or sounds. *Knowledge Adventure* also has a Question Mark icon that takes you to a graphic of a library reference room. Here, you can click on drawers in a card catalog to look things up or test your knowledge in a quiz game.

*Knowledge Adventure's*



Across the top of *Knowledge Adventure's* screen are icons that hyperlink to related screens describing different cultural aspects of the selected time and place.

## Undersea Adventure Adds Up to Fun for Kids

CHILDREN'S SOFTWARE  
by Daniel A. Begun

The Learning Co., maker of *Reader Rabbit*, has a new educational adventure, *Operation Neptune*, for kids ages 10 and older, and this time the focus is math.

In *Operation Neptune*, a sci-

entific mission in space has sent its secret data back to earth, but the ship has crash-landed in the South Pacific. As pilot of a submarine, you're assigned the top-secret mission of recovering the broken pieces of the capsule scattered about the labyrinths of the ocean bottom.

CONTINUES



## After Hours

### Neptune

CONTINUED

You maneuver the submarine through undersea caverns searching for pieces of the space capsule and data canisters; keep in mind that these pieces can be difficult to find. You have a limited supply of oxygen that will run out if you have too many run-ins with a variety of hostile sea creatures.

During your recovery mission, the submarine's on-board computer will prompt you to make calculations necessary for the mission. You will be asked to solve mathematical problems such as adding distances you have traveled and then converting the sum from meters to kilometers, or subtracting fractions and then converting your answer to decimals.

If you have a VGA display, you'll be impressed by the graphics; anything less and you are missing out. The game's sound and music, though, are not as strong. Even with the addition of a Sound Blaster board, I preferred to play with the sound turned off. The documentation is thorough and well written, but the game is so straightforward you won't need it.

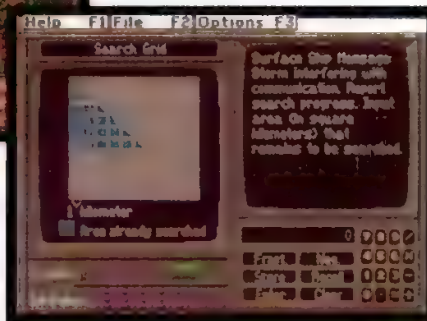
Any ten year old who has played computer games should have no trouble mastering *Operation Neptune*. More important, the game manages to successfully combine an exciting video arcade-style game with mathematical drills while still being fun. During the educational segments, your children will use addition, subtraction, multiplication, and division. They'll also work with fractions, read charts and graphs, figure out area and averages, and develop problem-solving skills.

#### List Price:

*Operation Neptune*, \$59.95.  
The Learning Co.,  
6493 Kaiser Dr.,



Game play stops in *Operation Neptune* while you help the on-board computer figure out this math problem.



Fremont, CA 94555; 800-852-2255, 510-792-2101.  
**Requires:** 512K RAM, CGA display or better, DOS 2.0 or later.

CIRCLE 473 ON READER SERVICE CARD

## Decyphering Messages in Search of Lost Mammals

CHILDREN'S SOFTWARE  
by Gayle Ehrenmann

If Carmen Sandiego decided to turn her attention to the wilderness, she might become the next C.Y.P.H.E.R. agent. Like the more familiar Carmen Sandiego games, *The Secret Codes of C.Y.P.H.E.R.: Operation Wildlife* is an educational game for children ages 8 and up organized around a mystery/detective theme. The difference here is that instead of tracking down criminals, you must decode secret messages.

The premise behind Tanager Software's \$49.95 children's package is that you're an undercover agent working for C.Y.P.H.E.R.'s Operation Wildlife unit. C.Y.P.H.E.R. (Courageous Young Partners in Hush-Hush Electronic Radiotelegraphy) is a top-secret organization that provides its clients with a

confidential message-delivery system, allowing them to send secret telegrams to one another. Each of these CYPHERGRAMS is coded, broken down into pieces, and dispersed throughout Discovery City. As a C.Y.P.H.E.R. agent, it's your job to find the pieces of the message, decode it, and deliver it.

To get the message bits, you must find the right section of the city for your contact meetings, retrieve clues to the identity of the mammal in question, then correctly identify it. If you can't figure out which mammal the clues refer to (they can be esoteric at times) or where in the city you're supposed to pick up the clues, you can turn to your trusty Microscan Watch for help: It's stocked with a review of the clues and the FunCyclopedia, an

on-line database of street names, coded alphabets and their translations, and mammal information.

All your possible choices of locale (specific areas of the city, the wildlife park) and action (look at contact sheets, access your Microscan Watch) are graphically depicted on the right side of the screen, while your current locale comprises the bulk of the display.

While the wildlife park is visually appealing, it doesn't seem to be particularly well integrated into the game. There's simply no real reason why you should be looking for mammals at the park; only two of the 19 cases you can choose from have anything to do with animals. The cases are also problematic because they go on far too long.

*The Secret Codes of C.Y.P.H.E.R.: Operation Wildlife* is an interesting and amusing concept that falls a bit short when it comes to narrative integration. As a means of teaching children about mammals and the art of decoding secret messages, it's a success, but it's no real threat to Carmen and her crew.

**List Price:** *The Secret Codes of C.Y.P.H.E.R.: Operation Wildlife*, \$49.95. Tanager Software, 1933 Davis St., #208, San Leandro, CA 94577; 800-841-2020, 510-430-0900.

**Requires:** 640K RAM, Hercules (monochrome), Tandy, EGA, or VGA display, DOS 3.0 or later.

CIRCLE 474 ON READER SERVICE CARD



*The Secret Codes of C.Y.P.H.E.R.* teaches kids about the animals in its wildlife park.

## What's My Angle? Teaches Geometry Different Ways

What's My Angle?

Twentysomething years ago, I was your typical high school student. I thought I knew all the angles. For example, I knew that by electing Interpretive Speech and Drama, I could avoid taking Geometry. After all, I thought, who really needs geometry? Who would have believed I'd be sitting here at my PC today catch-

ing up on some *real* angles, and enjoying it?

*What's My Angle?* (\$49.95), designed by Davidson & Associates for students ages 14 to adult, approaches geometry by offering five separate activities: GeoBoard, which teaches the fundamental concepts and lets students explore patterns and relationships; GeoLife, which presents everyday problems and

CONTINUES



## After Hours

### Angle?

CONTINUED

solves them using geometry; GeoConclusions, which reinforces proof and problem-solving skills; GeoProofs, in which the student must unscramble mixed-up proofs; and GeoGolf, a miniature-golf game that requires students to plot the angle of the golf ball to avoid course hazards and sink the putt.

The program puts life into what's arguably a dull topic. GeoLife offers "real-life" applications, such as helping Rosa the Rock Star position lights for a concert by calculating angles. When you solve problems, the characters (Rosa, A. J. the Astronaut, Chang the Carpenter, Fergie the Farmer, and Yvonne the Inventor) reward you with movement and sound. The GeoGolf game offers a miniature-

golf course, complete with hazards; there are 60 possible holes from which the program selects 18 at random. Students can instruct the game to show (or hide) the ball trail and an on-line protractor that helps estimate the correct angle for your next putt. One to four budding mathematicians can play at once, and the game keeps score.

*What's My Angle?* is easy to navigate. The pull-down menus of the Davidson Student Desktop Interface enable students to set program parameters and keep

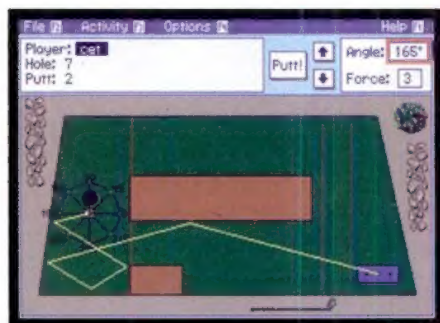
records of their progress. A glossary of 150 terms is accessible from within the activities. GeoLife, GeoConclusions, and GeoProofs offer on-line hints at your request, display a scoreboard, and with a 100 percent score, allow you to print a text or graphical certificate. GeoBoard contains a Tutorial section. Activities offer both beginner and advanced levels. If students don't answer a question correctly after two tries, the program displays the correct answer.

*What's My Angle?* covers a

year's worth of geometry. It's not the type of program you (or at least I) can blast through in a few hours; it takes time and effort. I'm progressing through the course, and I'm beginning to understand geometry and appreciate its value without the benefit of classroom instruction or a reference text. The program seems designed to maximize learning and minimize frustration. *What's My Angle?* activities and questions are sufficiently varied and challenging enough to keep my interest. My real-life golf scores are improving, too!

**List Price:** *What's My Angle?*, \$49.95. Davidson & Associates Inc., P.O. Box 2961, Torrance, CA 90509; 800-545-7677, 311-793-0600. **Requires:** 512K RAM, CGA display or better, DOS 2.1 or later. Hard disk, mouse recommended; supports AdLib, Sound Blaster sound cards.

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With your improved sense of geometry, the GeoGolf course in *What's My Angle?* shouldn't be hard to master.

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# Abort, Retry, Fail?

The Lighter Side of Personal Computing

## Next Week's Lesson at the Silicon Valley Assembly of God: How in the Beginning Moses Brought Down 25 Commandments, but 15 Were In Cross-Linked Sectors

From a Sunday news magazine report in the *The Dallas Morning News*, November 10, 1991:

"Lutheran pastor John C. Hildner recently told an Arlington seminar what religious message might be appropriate in our modern, user-friendly world. 'He might ask, "Why do you see the byte that is in your brother's eye, but don't see the megabyte that is in your own eye?"' the Rev. Hildner said. 'And the message probably would refer to a sin of transgression as an "imparity error" or suggest at confession, "Fail, retry or abort."' Unable to resist a pun, Mr. Hildner added an Old Testament allusion to computer lingo: 'Don't forget, in the story of Abraham's willing sacrifice of his son, Isaac, God supplied him with enough ram.'"

Just once before we die, we'd like to see a grammar-checker ad without a mistake: **Correct Grammar for Windows** ad.

Unlike [other grammar checkers] **Correct Grammar** rereads the latest edit before moving on. This feature lets you correct and edit your wiring in one pass.

—Kathleen Richard  
PC Computing

## CLASSIFIED INTELLIGENCE

**"Computer CD RUM—**Aggressive individual needed to maintain, modify & support a state-of-the-art PC based CD-Rum. Build & retrieval software for MS-DOS proficiency in C language & 2+ years of DBMS is required. Windows experience & previous CD-Rum background a plus. . . ."

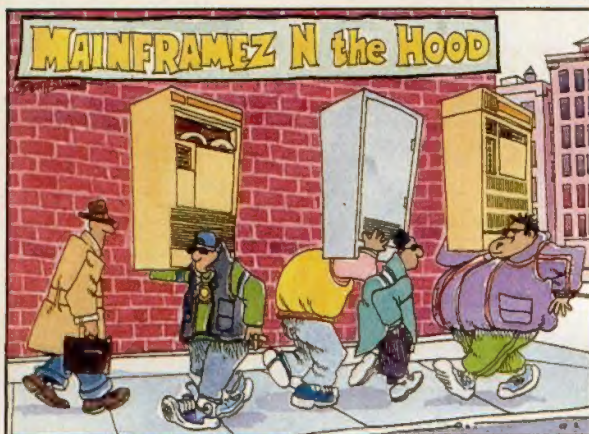
—*The Washington Post*, August 4, 1991

**"HARD DRIVE—**Micropolice, 382MB, ESDI, Brand new. \$850."

—*The Denver Post*, October 6, 1991

**"A Look Before You Leap:** Here's Help Publications presents their book, *A Look Before You Leap* (\$15.95). Increase your computer savvy before making the investment. As a potential computer user, you no longer need to "fear the unknown" with this clear English computer resource."

—Book ad, *PC Home Journal*, July/August 1991



CARTOON: RICHARD TENNANT



Ad in the Philadelphia Inquirer for Philadelphia-area appliance dealers.

## Tell 'em You Read This Article. They'll Think You're A Dork

"Here are some points to look for [when buying a PC]:

An 80386 chip. Tell the people at the store you want a '386,' since nobody uses the entire name of the chip any more. They'll think you're real savvy."

—*Syracuse Herald-Journal*, September 2, 1991

## Recover Impossible-To-Read Data . . .

"An act of prevention. Gibson Research Corporation's Spin-Rite software program reads hard-to-read and impossible-to-read data from a DOS hard disk. . . ."

—Symantec Corp. ad

## . . . Then Rescue Unerased Files

"Norton Utilities for System V helps you rescue unerased files & directories, diagnoses disk problems without damaging 'live' data, makes it easy to manage files, & replaces cumbersome expert system tools."

—Gibson Research Corp. ad



Don't you love the way this Dell computer works right out of the box?

## From Our Dream-Computer-Jobs Database, Bayou Edition. Successful Applicant Will Replace "Lefty" D'Artignan, Whose Typing Speed Recently Took a Turn for the Worse

"Data Entry Inventory Control. Data Entry with strong Lotus background. Willing to work hands-on with alligator skins. Salary negotiable. No live animals."

—*New Orleans Times Picayune*, August 11, 1991

If your entry is used in *Abort, Retry, Fail?* we'll send you \$50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of each entry are considered. Winners this issue: Betsy Simmacher (megabyte in your eye), Ann Avery (fabric software), Tim Schwab (80386 chip), Emil Gilliam (Impossible-to-read data), Rebecca S. Waggoner (rescue unerased files), R. Michael Munas & Kenneth E. Caine (Dell), Katherine Hosch (alligator data entry), Virginia E. Bergland (English computer resource), Chi-I Huang (Micropolice), Jeffrey J. Langr (CD RUM), Coe Johnson (edit your wiring). •





## 7 NOTEBOOK USERS WERE LOCKED IN A ROOM. LESS THAN 4 HOURS LATER, 6 OF THEM WERE DEAD.

OK, we didn't really lock anybody up. But an independent laboratory did run PC Magazine's Battery Rundown Test on 7 leading notebook computers. And we're happy to report that Dell came in dead last.

In fact, Dell's power management system and NiMH battery helped the 320N+ run a full 30 minutes longer than the nearest competitor. More than enough to get you through the next marathon meeting or epic plane flight.

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|--------------------------|------------|
| Toshiba T2000SXe         | 3:21 Hours |
| Compaq LTE 386s/20       | 3:05 Hours |
| TI Truemail 3000         | 2:32 Hours |
| Zenith MastersPort 386SL | 2:26 Hours |
| AST Premium Exec         | 2:08 Hours |
| IBM PS/2 Model 140SX     | 1:55 Hours |

Test in accordance with PC Magazine's testing parameters.

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|--------------------------------------------------------|---------|
| Toshiba T2000SXe—4 MB RAM and 60 MB Disk Drive         | \$3,778 |
| Compaq LTE 386s/20—4 MB RAM and 60 MB Disk Drive*      | \$4,297 |
| TI Truemail 3000—4 MB RAM and 60 MB Disk Drive         | \$3,098 |
| Zenith MastersPort 386SL—4 MB RAM and 60 MB Disk Drive | \$4,898 |
| AST Premium Exec.—4 MB RAM and 60 MB Disk Drive        | \$3,033 |
| IBM PS/2 Model 140SX—4 MB RAM and 60 MB Disk Drive     | \$4,134 |

Actual dealer prices may vary.

**DELL 320N+ \$2,499**

### TECH STUFF

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